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INTRODUCTION

This book is primarily intended to be of use to those who are engaged in, or who intend to engage in making designs for reproduction, either by the small quantity methods usually thought of as fine arts, or by the more varied and mostly quite different methods used in the factories of printers. To obtain the fullest and most satisfying result from any process of manufacture is presumably the aim of the designer, and it is, therefore, well worth while to study the different operations which are performed unseen, from the time of the departure of the design from the studio until the receipt of the finished printed work: in fact, without this knowledge an artist works at a great disadvantage.

Even though the designer will frequently not make working drawings for all his work, it is essential to the best results that he should understand what process he is working for when making his design. Only by such understanding can he eliminate the ravages of over-mechanization, and the consequent loss of feeling from his original work.

The processes involved are set forth, commencing with the simplest in technique and the most direct products of the artist's hand.

In printing there are three principal groups:

1. *Relief Printing*, in which that which is to print stands up to a certain height and all else is at a lower elevation. A roller with pigment on it passes over the raised surface, and paper is then pressed on it, touching only the raised and pigmented portion. Typical of this is wood-engraving.

2. *Intaglio*, in which the design is cut into a flat surface, which, having had pigment applied all over it, is then wiped or cleared on the face, leaving pigment in the recessed design. The print is then taken by pressing paper over the whole surface with soft backing, so that the pigment is picked out of the recesses. Typical of this is copperplate engraving.

3. *Planographic*, in which the design is in nature different from the plane surface on which it is formed, so that a pigmented roller passed over the whole surface delivers pigment only on the design. The paper is then pressed on the whole surface and only the pigment from the design is transferred to it. Typical of this is lithography.

In dealing with the autographic methods the aim will be to give general working directions without suggesting style of application, so that each student may be left free to develop individuality of attack.

H. C.

PART I

AUTOGRAPHIC METHODS

(A) RELIEF METHODS

WOOD-ENGRAVING

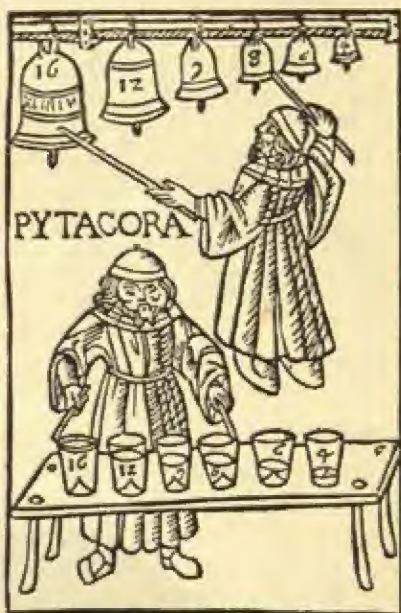
Any process for reproducing copies of an original design on to a flat surface of paper comes within the scope of this book, and the most simple of these is pure engraving on the end-grain of wood.

This is the process with which printing may be said to have been invented. Previously, manuscripts had been written out by scribes and illustrated by illuminators one copy at a time.

Then came the idea that a block of wood could be engraved so that all the letters of a book page stood up from a background that was cut away to a lower depth. The

face of this block was dabbed with black pigment from a leather pad, and paper was pressed upon it. It was a natural development from this to treat illustrations in the same way, transferring drawings to the face of a block of wood and engraving out all the background (1).

This book is not dealing with the history of printing, but it is interesting to examine some of the very satisfactory wood-blocks of early days prior to the invention of photo-engraving,



1. A very early wood-block.

when the engraver was admittedly an accomplished copyist (2).

There is crispness about the printed result better seen in the original prints than in the zinco from one of these shown here, which suggests that this use of wood-engraving could even today have a far greater use than it does. In any case, one sees that it is not *ipso facto* a 'heavy' process.



2. Copyist wood-engraving at its height.

The present revival of wood-engraving, however, is on an entirely different basis, in that the design is conceived from the outset in terms of the wood and the tools used.

The wood used is mostly box or holly. The pieces should be cut to type height, and it is usual to obtain them ready made to the size of the design to be engraved (3).¹

When designs are intended to be larger than the cross section of the holly or box-tree will allow, two or more blocks are



3. The wood-block.

joined together before they are surface planed and polished. These joints may be seen in the portion of an old block which, through being stored in a hot place, has begun to split up (4).

If such a piece of wood is inked on the surface with printers'

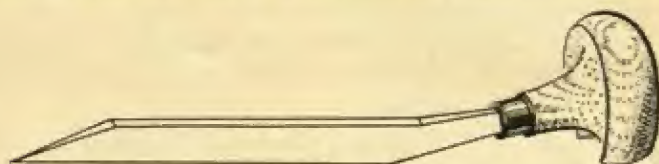
¹ Messrs. T. N. Lawrence, 1-4 Red Lion Passage, Fleet Street, are suppliers of all requisites for wood-engraving.

ink, and paper pressed on to it, the result is the simplest form of printing. Just the shape of the piece of wood will be shown in black on the paper. Virtually, such a print is illustration No. 1 to the *Genesis* which Paul Nash illustrated with wood-engravings for the Nonesuch Press (1924). In that series the simplest form of engraving is seen. The design is merely engraved into the surface of the polished wood with a spittstick, graver or other tool, so that each cut makes a white line, its width varying with its depth because of the section of the tool. The engraving must be of a sufficient depth to ensure that neither the inking roller nor the paper surface will still reach the wood.



4. A block that has split at its joints.

The tool (5) is held with the ball of the handle against the hollow of the palm, the blade projecting about $\frac{3}{4}$ " beyond the thumb and the first finger. If the student has a small hand, care



5. A typical tool (burin).

must be taken that the tool is not too long, or there will be no control over the cutting point. The design may be a series of fine white lines on a black ground, as in the *Genesis* illustrations, or most of the wood may be cleared (6), leaving black lines and surfaces. If the former, it is important that the tool used be

narrow and sharp as (7a), not as (7b), so that there will be no indecision as to what the pressure will cause to print and what



6. Wood-engraving in varied manners.

will remain clearly white. A block which shows both these techniques in one design is a wood-engraving entitled 'Meadow Saffron', in John Nash's illustrations to *Poisonous Plants* (Etchells & Macdonald, 1927).



(a)



(b)

7. The points of the burin:
(a) good, (b) unsuitable.

For broad white spaces the block must be cut deeply, so that the dip of ink roller and paper will not sag into these parts and print where it should not. Areas an inch or so broad must be nearly $\frac{1}{4}$ " deep, particularly if printing on damped hand-made paper is intended. In the laborious 'clearing' out of the whites, have the assistance of the wood-block supply man, who will 'rout' with a machine those parts indicated. This indication can be given by colouring the areas in question with white paint.



8. Two widths of scorper.

It is a good plan to black the whole surface of the wood with indian ink before starting to engrave, so that the work done is clearly seen.

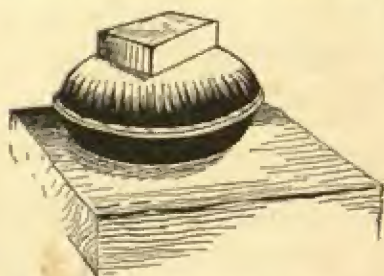
Besides the above-mentioned tools, a round-nosed scorper (8) is needed with which to clear away the larger areas. As work develops, other forms of tool can be added to get the desired effects. There

are, for example, tint tools being like the scorper but with a flat cutting edge instead of a rounded one, 'multiple' tools with several points which produce their own effects, but the simpler tools should be mastered before the more complex ones are used.

The natural development beyond this engraving in white on a black ground is to conceive the design in black and to cut away the wood where the paper is to remain unprinted. Such a print should still have a very marked difference in technique from a drawing with brush or pen, because of the crispness resulting from right wood-engraving, and because all cross-hatchings and shadings will be in white lines working away the black, and not in black lines covering up the white.

It is a peculiar advantage of wood-engraving that when a very soft edge to a cross-hatched area is wanted, the level of the face of the wood can be very slightly lowered where the softening is to take effect, before the hatching is engraved. This edge will gradually cease to be reached by the ink roller and the paper in printing.

During engraving the block is supported on a sandbag, usually made of leather. This may be raised on a piece of wood a few inches high from the top of the table as is found convenient. The sandbag enables the block to be twisted with the left hand during the engraving of curved lines, and in general to be turned about freely whilst giving the right degree of firmness.



9. The wood-engraver's sandbag.

It is also a possible development to engrave several end-grain blocks and print them in a series of colours over one another to produce a multicoloured print (10). For this it is necessary to make a design first, and then to trace out a key which can be rubbed face down on to the set of blocks, one for each colour.

This is a very useful practice for all students of printing design, because it brings out an elementary principle inherent in printing, which is, that each colour is a separate 'working' with a uniform strength of pigment, the effective strength of the colour being varied only as the block is hatched away. An example of this hatching carried to great lengths may be seen in the coloured wood-engravings of the Caldecott Books for Children.

Some means of registering the colours in relation to one another must be provided, unless the design is made in such a way that one of the colours, not necessarily the darkest one, forms a fairly 'general statement' of the whole composition. If this is the case, this colour can be printed first, and the other colours fitted to it.

Before leaving the engraving of the block it is well to remember that, in the unfortunate event of an alteration being necessary the block supply man can drill out a portion of the block and fix in a new piece of wood in any position indicated.

PRINTING THE BLOCK

In taking impressions from the block, the aim should be to use as fine a coating of stiffish 'letterpress' printing ink as possible, and give a firm pressure. The paper is pressed to the block by a cast-iron plate or 'platen', but it cannot be expected that the iron surface and the hardwood surface of the block can be so accurate that, with one sheet of paper between them, an even pressure would be obtainable all over the block. That would be the ideal, but in practice a certain amount of 'give' must be provided between the iron platen and the back of the printing paper. This is provided by laying over the printing paper about six sheets of newspaper or 'packing'.

It is a frequent experience, when looking at students' presses, even in important technical schools, to find six or eight sheets of blotting paper and a whole copy of *The Times*, folded in



10. A set of wood-engraved blocks which print over one another to form a design.

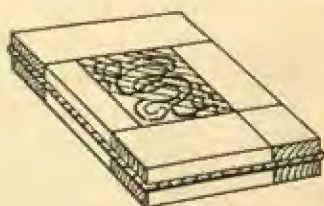
quarters, used for this purpose—a 'feather-bed' method of printing which inevitably produces a spongy and unsatisfactory print.

DAMPING PAPER

Paper, if Japanese or *other* hand-made, should be damped before printing, because it is too harsh in its dry state, and would not lift the ink kindly from the block without overmuch ink being applied. Thoroughly immerse alternate sheets of the paper in water and then lay in a pile between two sheets of zinc, with a weighted board on top of all, and leave it thus until the sheets are evenly damped. If a thin Japanese paper is to be used which will not stand dipping in water, it must be laid sheet by sheet between commoner paper that is already damped in the way described.

It is best to part and re-stack the paper during its standing period, giving alternate sheets a half-turn, and replacing the weight so that the moisture may be evenly distributed. It is well to leave the paper overnight if possible, but if time presses, and the damping is carefully done, an hour or two should suffice.

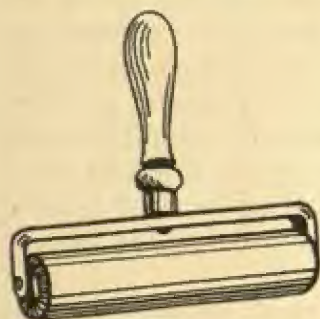
If there is no access to a press for proofing, the block must be carefully inked with the roller and then laid face up on a table, with other blocks of the same height placed round it (11), uninked. The whole bunch must be tied



11. The inked wood-block ready for hand-printing.

round firmly with string and the printing paper laid face down carefully over the inked block. The surrounding surface of the other blocks will be found very helpful in bearing up the margins, and their edges will also be useful as a guide to the edges of the sheets when printing several colour-blocks over one another.

The best method of applying ink to the block is to use a printers' small hand-roller. The roller (12) is cast from a composition of glue, treacle and glycerine, which is resilient and tacky. When not in use, it must be hung up in such a way that the composition does not touch any other surface, and it must be washed with turps or petrol before being put away, even for one night, or the ink will dry on the surface.



12. The hand-roller.

If the roller becomes hard and non-tacky, it can be refreshed by sponging with hot water, but after a time it will need to be re-cast with rejuvenated composition.

A very useful form of 'dabber' may be made (13) by obtaining from a friendly printer a few scraps or trimmings of clean, fresh roller composition. These must be melted in a tin placed in a pan of hot water, in the manner of a glue-pot,

and then one or two dabbers must be cast in the bottom of a small tumbler or jelly jar. When the composition is set, it can easily be taken from the impromptu mould by placing the mould in very hot water for a few moments, so that the surface of the composition re-melts slightly. These dabbers must be kept lying on their upper surfaces so that the glazed and slightly rounded working surface formed by the bottom of the mould may not be spoiled.



13. The dabber.

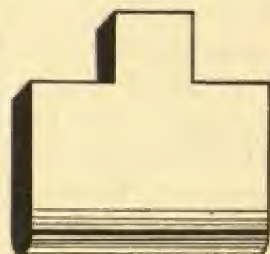
The ink must be worked out to a thin film with the roller or dabber, on a slab, and then applied to the surface of the block until a thin, even film is imparted.

An excellent ink slab is made with a sheet of plate glass over white American cloth: the white surface shows up colours well, and the glass is easily cleaned.

It is a common fault at first to use an ink far too much reduced in consistency, whereas the minimum amount of a stiff ink, coupled with adequate pressure, is a sure way of getting a good, clear print.

After inking the block, two or three sheets of cartridge paper must be laid over the printing paper, and with a hard boxwood rubber (14) the cartridge paper must be worked over evenly and firmly, the whole held securely with the other hand to prevent slipping.

Wood is sometimes finely engraved for intaglio printing, but this is technically so nearly akin to copper-plate engraving that it can readily be understood by reference to that section. No heat can be used in printing, so that a thinner ink is necessary.



14. Boxwood rubber.

USE BY PRINTERS

Wood-engraving is a logical partner of typography. An essential crispness is natural to both. If the type is of good design and the wood-block is equivalent in weight, the two will sort well together. Wood-engraving is, of course, slower than drawing, but it has this advantage, that the printer can make direct use of the artist's work.

There are, however, points to remember. The size of the block cannot be altered, and so must be clearly predetermined. Reduced or enlarged line blocks are sometimes made from prints of wood-engravings, but much of the sharpness is thereby jeopardized and the labour of engraving is wasted. As good a result is obtained with 'scraper-board', which is dealt with later. For printing large editions, and in newspaper work, it is not possible to print from the wood, as the blocks would wear out before completion of the printing.

DUPLICATING OF WOOD-ENGRAVINGS

'Electrotype' duplicates, therefore, have to be made. Roughly speaking, the process is this. The wood-block is pressed firmly into the surface of a tray of hard wax and withdrawn, leaving a 'female' impression in the wax. The surface of the wax is then dusted with finely powdered graphite. The tray is hung in an electrolytic bath with a copper plate, and the copper is deposited on the graphited surface of the wax, forming a thin copper shell. This shell is later peeled from the wax. Soft metal is poured into the back of it, and planed off when cold. A copper duplicate of the wood-engraving is thus formed. If well made, little of the quality of the original is lost.

A cheaper form of duplicate is the 'stereotype', but this cannot be made from a wood-engraving, as the heat necessary to dry the papier mâché mould or 'flong' will not pass through the wood. A stereotype may, however, be briefly described as follows. A papier mâché mould is made from a metal relief printing block by first making a composite sheet of tissue paper and blotting paper and finally cartridge paper, in several successive layers, held together by paste of a special nature. This composite sheet is laid on the metal relief block and beaten evenly and vigorously on the back with a hard, flat-surfaced brush which has a long handle. The beating is continued until the papier mâché has gone down into all the interstices of the original. Then a dry sheet of woollen blanket is laid on the top and the whole put into a heated press and screwed down.

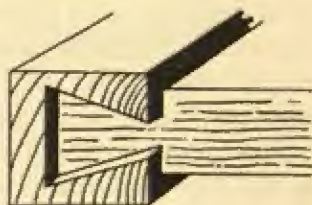
After twenty minutes or so, the mould, or 'matrix' as it is now called, will be baked quite hard, and all the moisture will have been taken out of it into the blanket.

The matrix is now placed in a special casting box and molten stereotype metal is poured in. Thus a plate about $\frac{1}{8}$ " thick is formed, with a duplicate of the original in relief on one face.

WOODCUTTING

Woodcutting differs from wood-engraving in that the work is done on the side, or plank surface of a softer wood such as English cherry. The masses, or printing surfaces, are cut around with a knife, and the whites are cleared out thereafter with gouges and chisels.

The blocks have to be specially built up, because printing is done with a mixture of water-colour and rice-flour paste, which would cause the soft wood to warp or split if it were not held by clamping at the ends (15). The block must be larger than the paper will finally be on which the print is to be made.



15. The clamped end of a cherry-wood board.

Woodcuts are suitable for limited editions of prints, in surfaces of graduated or flat colour, as exemplified by the Japanese wood-block prints; the wood being soft, it is not capable of standing up to heavy pressure in a printing machine.

The first step is to prepare a design, and the first subject may very well be in monochrome for printing in black, or a colour. In woodcutting, the block is coloured for printing with a brush instead of with a roller, thus the colour can be applied thicker in one part than another, resulting in gradation of tone. The block can be coloured with brushes of different colour at the same time, thus printing two or more colours at once.

A great deal of hand control is necessary for each print; in fact, the blocks when cut are scarcely more than a key to the design: each print is largely a piece of individual work.

The design is first painted direct on to the plank, or, if preferred, on paper, and traced on to the plank. Then, with a

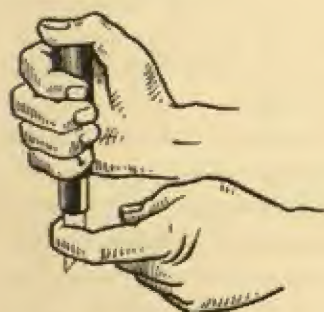
special knife (16) held firmly in the fist, the thumb over the handle, the cuts are made towards the body into the plank with the flat side of the blade against the colour shape. The course



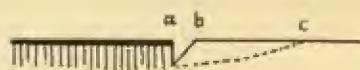
16. Wood-cutting knife.

of the blade is assisted by a finger of the left hand (17). A strip of wood clamped or screwed to the front edge of the table is most useful in keeping the block firm.

In this way, every colour shape is cut all round to a depth of $\frac{1}{16}$ " or so. The cuts must be almost vertical, the wall being sloped slightly, but very slightly, outwards (18a); the colour edge must never be undercut. A second cut is made against the first, to clear a V-shaped groove (18b). Next, with wood-carver's gouges, the white spaces are cleared away to a maximum depth of $\frac{1}{4}$ " from the bottom of the groove outward, as shown by the dotted line (18c).



17. The grip of the knife.



18. The three stages in cutting.



19. The wood cleared away from the printing surface.

It is not necessary to clear away all the background, but it must be cleared outwards to about $1\frac{1}{2}$ " all round the design, so that when the colour is applied with a brush there will be no difficulty in avoiding the surrounding wood (19). A certain amount of fine line work can be left, especially in the direction

of the grain. Very fine line work is apparent in most of the Japanese prints, but practice more than anything else will show what is possible.

Finally, for guidance in laying on the sheets of paper, register marks are cut, a corner angle and a side edge being left standing. The wood is shelved out around them so that the corner and then the edge of each sheet may be laid easily into them for positioning each print (20).



20. The lay marks.

Dry powder colour, mixed with water and a little thin rice-flour paste, are the colouring ingredients used. The block is first damped over with a sponge and clean water to prevent undue absorption, and then the colour is brushed on thoroughly with a soft flat brush of a size suitable to the design.

A sheet of Japanese paper, already damped, is laid down to the corner and edge guides, and then over the whole design. Holding it firmly in position by the margins, the impression is made by rubbing evenly, in a systematic way, over the back of the whole sheet with a 'baren' (21), i.e. a flattish, hard, round pad with a smooth, slippery face. Artists' colourmen usually supply the genuine Japanese baren, which is covered in bamboo sheath, but one covered with oiled parchment may be used. It must, however, be waterproof and smooth, or it will not slip over the damp paper without dragging on it. When printing on very thin paper, it may be found expedient to lay over it a sheet of stronger paper to take the friction of the baren.



21. The baren for printing.

If a second or third colour is to be printed, a further plank must have the key traced on it, and the cutting is proceeded with once more, taking care to trace the register marks exactly on each plank so that when the sheets of paper are laid on to the different planks the design will fit together properly.

In point of fact, of course, all the cutting must be done before printing is started, and care must be taken to keep the paper evenly damped whilst the various colours are printed, for, if the design is at all a large one, the size of the paper will vary with its humidity, and the colours will not fit one another.

LINOLEUM ENGRAVING AND CUTTING

Lino, as it is usually called, can be either engraved or cut in much the same techniques as wood. It has no directional grain. Being soft, it is easy to work; it has less strength than wood to stand up to pressure in printing, and it is not possible to ensure that fine lines, edges or serrations can be preserved. It cannot be moulded for duplication, either by stereotyping or electrotyping. Its principal use may be said to be for practice in schools, because it is a cheap material, and the less hardened muscles of children are more equal to the work of cutting lino than wood or metals.

For either cutting or engraving, plain, dark-coloured floor linoleum is obtained. The surface must be whitened. House decorators' ordinary white 'undercoating' paint is good for this. It dries very quickly, leaving a matt surface on which drawing can easily be done with a pencil, or it can be painted on with a brush and water-colour. For multicolour work, tracings can be made from a key through carbon paper.

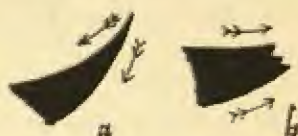
Engraving is best done with a small, acute-angled, wood-carver's V-tool (22). The tang should be cut off and the end wrapped in a ball of rag and covered with leather. The curved

form of tool is best. When cutting, the hand must be kept low so that the tool will glide smoothly through the lino.



22. The principal lino tool.

This tool has almost universal uses. Its angle gives just the right degree of slope on the wall of the printing surfaces, and for narrow white lines it cuts out a clean, sheer depth that prints cleanly. It must be kept very sharp and must always be pushed towards the supporting mass of linoleum, or the tips of leaves, etc., will break away, as (23*b*) when (23*a*) was intended.



23. A warning.

Some lino-engravers use a fragment of an old umbrella rib, which will sharpen into a nice little gouge, and, of course, wood-carvers' curved gouges of various sizes can be obtained. Artists' colourmen now sell sets of nib-like lino tools with suitable handles, in boxes. They are cheap and handy, but not very solid to work with.



24. Gouges for clearing.

In addition to these actual engraving tools, curved gouges from $\frac{1}{16}$ " to $\frac{3}{8}$ " wide (24) may be obtained, set in similar handles to that described. These are for clearing away white areas,

which should be stripped nearly down to the canvas. In fact, if they are more than an inch or so across, they are best cut right through, canvas and all, with a knife—that is, if the design is not thereby disintegrated.

Designs with fine, outlying details are definitely not practical. A stork's beak (25*a*), for example, would probably become blotched and thick (25*b*) if left against a white sky, owing to the natural instability of lino.



25. (b) might result when (a) was intended.

Lino can also be cut in just the same way, and with the same knife as cherry-wood blocks described in the previous section, but as the lino closes up completely after the knife has passed, it is difficult to see what is being done when making the second cut to clear out the V preparatory to clearing away the whites with a gouge.

If the block is to be printed by hand without the use of a press, the same practice as to clearing away of ground may be followed as in cherry-wood block work. The inking will probably be done with a small composition roller or dabber, and it may be helpful to cut a mask of cartridge paper to lay over the background after inking, so that the margins of the printing paper are kept clean.



26. The lino block is mounted type high.

As to pigment, either letterpress printing ink, black or coloured, or the water-colour and rice-flour paste used in the cherry block prints may be used.

If, however, the block is to be handed over to a printer to be included with type matter (26) it must be glued type high on a piece of planed mahogany, and the wood chiselled away in the larger whites so that it will not make contact with the roller or the paper in printing. 'Type height' is equal to the

diameter of a one-shilling piece. The mounting must be very exactly done, with the lino pressed into tight contact with the wood. It is better to leave the mounting to the printer, who has seasoned wood ready cut to a standard thickness.

RUBBER ENGRAVING AND CUTTING

Sheets of flooring rubber may be cut in just the same way as linoleum, and with the same tools. The cuts forming the edge of the printing surfaces should, however, be still more vertical. In fact, they should be at right angles to the printing face, and therefore if the V tool is used it should be held at an angle so that the edge that forms the printing mass is vertical (27). The printing surface is to the right of the double cut. The V tool must however, be very sharp and ground at a keen angle. Alternatively, a very sharp knife like that used for cherry-wood blocks may be used if preferred.

Indiarubber is not likely to be used as a medium for fine individual prints, but it has come into vogue for printing with water-colour inks, which are in quality very like gouache.



27. Angle of cut for rubber.

Owing to the softness of the rubber, only broad surfaces can be worked. Fine lines would squash. A certain degree of softening of the edges can be accomplished by slitting the edges of the rubber (28), but this is apt to print somewhat messily. However, if it is attempted, a safety razor blade set in an improvised holder will be found a good tool, as being very keen, it will not drag the rubber, more particularly if the blade is slightly oiled.



28. Edges of rubber may be thus relieved.

The advantage of rubber blocks, whether pigmented with water-ink or ordinary printer's ink, is that very little pressure is required to carry the pigment into every crevice of the paper surface. It is

usually the practice for these rubber blocks to be cut by the trade from finished designs, but a little experimenting with a sharp tool on the material will soon show the would-be designer what is the characteristic of this easily cut material.

A great advantage of the Jean Berté water-inks¹ supplied for use with rubber blocks is that the medium being water instead of oil, absolutely pure tints of great luminosity can be obtained, together with a completely matt surface. This matt surface is possible even when several colours are printed over one another. Colours are all either transparent or opaque at will, so that blendings can be controlled.

If fine, detailed work which cannot be cut is required, a zinc line block (*see* later chapter) may be made from a black drawing and a rubber block cast from this. In this case, very open cross-hatchings can be used, and the block is printed with the water-inks. In such cases, however, it is often better to print rubber blocks with water-colour for flat surfaces, in conjunction with zinc line blocks of details printed from the metal in the usual oil-inks, the latter not necessarily being designed for printing in a dark colour.

One can also contrast highly-glazed solid masses of glossy oil printing ink with the matt surface of water-inks.

Some effective work has been done with water-inks, with an over-printing in an open screen (65- or 80-line) half-tone, or in half-tone offset (*see* later chapters), in grey or black to produce modelling on top of the colour. It is a general characteristic of much work done with water-inks that they are made with full strengths of the most vivid colours, whereas the process could give pleasant results by the reduction of these pure colours to pale tints.

It must, however, be realized that water-inks remain soluble in water after printing, and are not, therefore, always practical. A book-jacket, for example, if spattered with rain, would smear.

¹ These inks are supplied by Wallace & Tiernan Ltd., Power Road, Gunnersbury, W.4.

(B) INTAGLIO METHODS

COPPER ENGRAVING

We now come to the series of intaglio methods of taking prints, and of these, engraving on plates of copper $\frac{1}{16}$ " thick is the first for consideration. The copper is highly polished on one side, and into this surface the design has to be engraved with burins very similar to those used for the end-grain of wood. These are sharpened at an angle more nearly at right angles to the length of the tool than for work on wood, so that the cutting point may have more support and sturdiness (29).



29. Burin points for copper engraving.

The method of working gives that clear cut, incisive style which is the chief characteristic of good copperplate engraving.

The incision must never exceed $\frac{1}{14}$ " in depth, and will usually be much less. The method of printing is to rub a stiff ink all over the plate and work it into the engraved parts, after which the polished surface is wiped clean. The paper is then put against the plate and passed through a mangle-like roller press, when the ink is transferred to the paper from the recesses of the plate.

From this brief preliminary description of the method of taking copies it will be seen that only comparatively narrow individual lines can be engraved, and that large areas of solid colour are not available in this process, for the rag would take the ink out of them in the wiping off of surplus ink. This suggests that the building-up of such tone-surfaces as may be required in the design is done by a series of fine lines made with the burin. Such textures should be kept open, orderly and defined, if the crisp quality of copper engraving is to have its full charm.

If the lines are too deeply cut, they will hold too much ink, and this excess will ooze out in printing, causing a blurred effect.

KEYING THE DESIGN

The first step after having made the design approximately on paper, is to transfer a key of it on to the face of the copper as a guide. This is most simply done by first applying a wax 'etching ground' to the copper surface (*see* section on Etching), as the wax receives marks more easily than does the clean copper surface. A pencil tracing of the main lines of the design is then made. For masses that will be shaded or hatched, the contour only need be put in, not the detail of the hatching.

The amount of detail put into the key is a matter of individual opinion. It must be remembered that the finished result aimed at is an engraving as such, and not an engraved reproduction of a pen or pencil drawing.

Either this key is laid face down on the waxed ground, and the plate and key pulled through the copperplate press, or the key is rubbed down with a hardwood rubber like that illustrated on page 11. The pencil line will thus be transferred faintly, but sufficiently, to the plate.

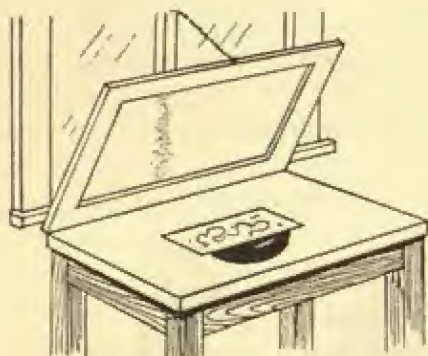
Another method which gives a still finer key is as follows. A thin sheet of 'keying gelatine' with smooth surface is obtained, and pinned down over the design with a hardish surface underneath. With a darning needle set in a holder, or a sharp drypoint needle, scratches are lightly and neatly made into the gelatine following the full outline of the design. The gelatine is removed and placed on a piece of card or other hard, smooth surface, and some engraver's ink (reduced a little according to personal judgement) is rubbed into the scratched key. Finally, the surplus ink is wiped off the face of the gelatine, giving a key transfer ready to put down on the plate in the same way as described above for a pencil key.

Great care must, of course, be taken that the key does not slip while it is being made. If the gelatine is larger than the copper, it can be pinned down on a drawing board, the plate having first been similarly fixed at the edges with pins. After

putting down the key, a certain amount of additional marking-in may be done on the wax with a blunt steel point, before engraving is started.

THE ENGRAVER'S TABLE

Copper is a fluent, grainless material, and works sweetly, but a comfortable working position at a table facing the light is essential. The table-top should be about 4" higher than the



30. The engraver's table.

usual table height, and the light, if coming directly from a facing window, must be veiled by a frame with tissue paper stretched over it, so that the eyes are not bothered by the reflection (30).

For small plates, some engravers work with the copper lying on a sand-filled leather pad, which makes it easy to turn the plate with the left hand, while the right hand is working the



31. The steel burnisher.

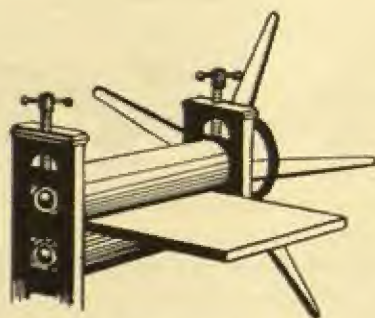
burin. This freedom is almost essential when cutting firm, curved lines, as the burin cannot easily both move forward and sweep round at the same time. Others prefer to have the plate

firmly on the table before them, but it is well then to lay it on a sheet of felt so that it will not slip about uncomfortably.

Corrections, if necessary, are made by first scraping away the face of the copper locally until the work already cut disappears. The face is then re-surfaced by first rubbing with charcoal and oil, then with rouge and oil, and finally burnishing with a steel burnisher (31). This process, however, thins the plate and should be avoided.

PRINTING FROM A COPPERPLATE

When all the engraving has been completed, prints are made in a press (32) comprising two large steel rollers, one above the other, with a sliding bed-plate of cast iron lying on the lower



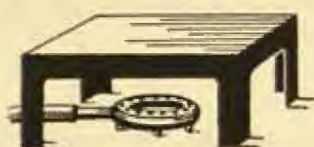
32. The intaglio plate press.

one. The upper roller on large presses has gearing and a cranked handle to turn it, or, if small, it has spokes to pull it round, without gearing, as shown in the illustration.

The copperplate is warmed face upwards on a heating plate. This consists of an iron plate with a sheet of asbestos over it and a gas ring underneath (33). When warmed enough, a stick of special copperplate ink is rubbed all over its surface and worked into the engraving with the thumb or with a piece of wood covered with thick leather (34). It is important to keep

this leather rubber and the ink in a tin box when not in use, so that they will be free from dust or grit, as the least particle of hard matter scratches the plate. These accidental scratches retain ink and will print.

After the ink is thoroughly worked into the plate, the surface is cleared. This is done first by scraping with pieces of oiled



33. The heating plate.

card (35), cut to a conveniently small size (say 2" squares). The ink so gathered may be saved for future use. When the scraping is finished, a succession of little pads of muslin are used to wipe the face quite clean.

In all this clearing, care must be taken to work across the lines of the work rather than along them, otherwise the ink will be wiped out of the engraving as well as off the surface. This is not easy when the lines go in all directions in the same part of the plate, but the wider lines must be guarded, as the ink wipes most easily out of them.



34. The rubbing-in pad.

The bed-plate of the press has a thin sheet of smooth felt on it, and on this the cleaned plate is laid face up. A piece of damped plate or Japanese paper is then laid on it. A couple of layers of similar thin felt are laid on top, and the whole is then turned through the press.

Pressure will vary with the size of the plate and the nature of the engraving, and screws are provided on the bearings for adjusting this. It is important that no check should occur in turning the press across the width of the plate, or a mark will result on the print. The plate is lifted out of the back of the

press, and the paper carefully peeled from it. In doing so, one corner is raised a little first, and if there is the slightest inclination of the ink to stay in the plate, or of the paper surface to tear (which may happen if the room is cold), the plate is warmed slightly over the heating box to soften the ink, but not too much, or it will run. The plate is then inked again and proceeded with as before for each copy.



35. A piece of card for removing ink.

There is a considerable use for copperplate engraving for letterheadings, cheques, share certificates, and maps, which are, however, not printed direct from the copper. A print is taken from the copper with a greasy ink, in the manner described above. This is then transferred to a zinc sheet, which is printed lithographically in an 'offset' press; this method will be dealt with in the section on Lithography.

Copperplate printing is also used for visiting cards and bookplates, which are, on the other hand, usually printed direct from the copper.

Book illustrations are occasionally printed direct from the copper, but in such cases the copperplate must be steel-faced, to help it to withstand the pressure of printing a number of copies without the loss of fine details.

There is ample material for study in the work of masters of copper engraving, such as Hollar, Dürer, Stephen Gooden, and Robert Austin.

DRYPOINT

Drypoint is worked on a highly burnished copper plate as for engraving. The work is scratched directly on to the face of the plate with a sharp-pointed steel needle (36), or with a diamond 'needle', and it is this directness of method that gives drypoint its chief attraction. The point raises a slight burr on the metal, which retains the ink when prints are taken. This burr can be

scraped away in light parts of the plate with a scraper (38) as used in Mezzotint.

It is the burr, together with the firmly drawn nature of the lines, which make the essential difference of appearance



36. Above: steel drypoint.
Below: diamond drypoint.

between a drypoint and an engraving or etching. More muscular control is, of course, required than in pencil drawing.

Only quite fine lines can result from the drypoint needle, but they are scratched deep or shallow, according to whether they are to print strongly or faintly, and this again indicates a characteristic of the method. Corrections, if absolutely necessary, are made in the manner described for correcting an engraved plate, but the work being more delicate, corrections should be avoided.

Pigmenting of the plate is done much as for engraving. In wiping off the surplus of thin colour, a slight drag occurs, and this gives scope for variety of treatment. This may be controlled very exactly by wiping with the flat of the hand, and then finally with a muslin pad.

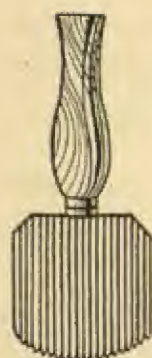
After pigmenting and wiping the plate, a copy is taken on dampened paper in the copperplate press with light pressure.

Drypoint and engraving have both been carried out on zinc as opposed to the more usual copper. There is little advantage except in the cheapness of the metal for large work. In general, zinc is a shorter grained and more brittle metal, so that it does not work sweetly and is liable to break away.

Some examples of drypoint work at its best are to be found in the plates made by Rembrandt.

Drypoint is used in conjunction with aquatint, and the combination of methods is described under that head.

MEZZOTINT



37. The mezzotint rocker.

This is a laborious process not now much practised. It gives only gradation of surface tint, and was largely used before the advent of half-tone for the monochrome reproduction of prints after paintings.

A copperplate is worked up to a toothed surface, deeper or less deep in parts, according to whether light or dark tones are required. This is done with a steel rocking tool (37), which has a curved edge with sharp teeth which dig little pits in the copper and turn up little spikes. The rocker is worked across the plate in many directions until a texture is built up, varying only broadly with the tones of the design.

The final work is done, and the design formed with a scraper (38), with which the toothed surface is worked away again, until the recesses left in the copper will hold just enough ink to give the paleness or strength of tone required. The plate thus becomes thinner in the lighter parts of the design than in



38. The scraper.

the darker parts, but this irregularity is absorbed by the blankets backing the printing paper in the press.

In printing, the plate is filled with ink and then wiped off with a succession of rags. The burred teeth which remain in the darker portion of the design hold a lot of colour, and the lighter parts of the design where no teeth and only shallow pits remain wipe off cleanly so that very little colour is held. Thus a rich gradation of tone is produced in the print, which is made on damped paper in a copperplate press. One of the best exponents of mezzotint was John Raphael Smith, though

the process might suggest fresh application to a student taking it up for itself rather than as a reproduction process.

ETCHING

We come now to the first process in which the plate is not produced by purely manual work.

A copper plate is warmed and coated on the face by rubbing with wax and asphaltum to produce a thin, acid-resisting film or 'ground'. When cool, this is smoked over a tallow dip to produce a black surface. The back of the plate is painted over with shellac to protect it also from the acid in etching.

The design is then drawn on to the copper with an etching needle, which removes the wax ground and lays bare the copper beneath it. The etching needle is very similar to a drypoint needle, but is used not quite so sharp, for it does not cut the copper itself.

The plate is then placed in a bath of diluted nitric acid until the copper in the parts which are to be lightest is eaten out, or etched to a sufficient depth. After this, the plate is lifted out and dried, and those parts judged deep enough are covered with acid-resisting varnish. The plate goes back into the acid, and this process is repeated until even the darkest parts are bitten deeply enough into the metal. A photographic developing dish is convenient for this purpose.

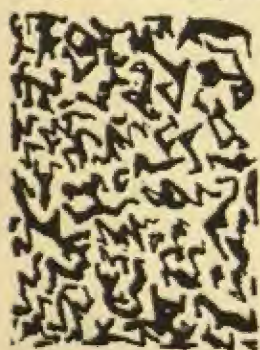
The plate is finally cleared of wax and a trial print taken. After that, it can be grounded again, but not smoked, and with the trial print and the work already done as guide, still further needle work and etching can be done until the desired state is reached. If many copies are to be taken, the plate may be steel-faced.

Prints are taken in the copperplate press in the way described for engravings. The essential characteristic of the process is in the lightly-drawn nature of the line, but the ease of drawing with the blunt needle on the wax should not be allowed to lead to sketchy and uncontrolled work. For examples of this process, the works of Meryon and of William Strang should be examined.

AQUATINT

This is a process requiring patience and much practice, but it is one with possibilities, either alone or in conjunction with one or other of the line processes previously mentioned. Used alone, it gives only flat tints of varying depths and without detail. It is an etching process, and has been used recently by Alexeieff in his illustrations to Gogol's *The Diary of a Madman* (The Cresset Press, 1929), where it was associated with drypoint.

A copper plate is prepared for aquatint as follows. It is first flooded evenly with a solution of shellac in alcohol, which, as it dries, will 'craze' or crack all over the plate, leaving minute crevices of unprotected copper. A texture is formed as shown by the micro-enlargement (39). The plate is then etched by a succession of immersions in the acid bath. After each etching the plate is dried, and those portions that are deep enough are



39. Texture of aquatint enlarged.

stopped from further activity by painting over with a non-crazing resist. From this it will be seen that only effects of a broad water-colour nature are obtainable, and that one works from light to dark, stopping-out first the lightest tints and leaving the darkest tones till last.

Extreme care is necessary in the preparation of the crazed surface on the plate. The exact strength of the shellac solution and the rapidity of drying will both greatly affect the quality or scale of the crazing. The flooding of the plate with shellac must be free from the slightest exposure to dust. Drying must be carried out in complete protection from draughts in an exactly horizontal position and in even temperature, otherwise an irregular texture will result.

In the case of *The Diary of a Madman* illustrations already

referred to, it would seem that a drypoint plate was first made of the design in outline, leaving all surface tinting to be carried out afterwards by the aquatint method. A series of plates was thus produced which, when steel-faced, were capable of giving a considerable number of good copies.

There is no reason why engraving and etching should not be equally well associated with aquatint for tone work. For examples of the older school of pure aquatint the work of Aikerman might be studied.

LINOLEUM DRYPOINT

Although it is not much used it will be found quite a worthwhile practice for young hands to make drypoints on linoleum. It is easy to work and cheap.

Thin brown linoleum, as hard as possible, should be obtained. Old stock that has become hard with age is the best. Soft thick linoleum is of no use for this work.

Cut the lino to the size required, and drawing-pin it down on a wooden board. Paint it over thinly with white body water-colour, and when this is dry lightly outline a design in pencil on it.

The engraving is best done with a cobbler's awl which has been sharpened on two sides so that it has a tiny knife-edge point. Engraving must be very shallow, and at first only outlines should be made. Later, hatchings may be added to produce tones.

When the work is complete, the white is washed off and the linoleum dried.

Pigmenting is done with oil-colour and an oil-colour brush, working the colour well into the lines in all directions.

With the corner of a piece of linen rag, the colour is rubbed into the work and afterwards the surface of the linoleum is wiped clean with the same linen rag.

Soft paper is required for taking prints, and this should be

very thoroughly damped, but not so much that water actually drips from it. Japanese paper also may be used. The damped paper is laid on the linoleum with a piece of strong dry paper over it, and a bone folder, or the back of a spoon, is used to rub with even strokes from left to right and from top to bottom. The rubbing must be carefully and thoroughly done so that all parts of the design are covered.

The ordinary household wringer may be used for taking prints with success and without damaging the wringer.

The linoleum 'plate' must be washed with turps or petrol when the last copy has been made, for if the oil-colour dries in the lines it would be spoilt for further copies.

With care, up to a hundred impressions have been taken from such a work. It must not be expected that the background can be wiped as clean as could a similar plate of copper, but the toned ground is a not unpleasant characteristic of the linoleum drypoint.

STEEL ENGRAVING

The essential difference between engraving on steel and engraving on copper arises from the fact that steel is a harder metal. With steel, more finely engraved work is almost inevitable, for although the engraving is done on the steel, in a 'softened' state, the metal, even in that state, is much harder than copper. The hardness of the metal should in itself indicate a sterner discipline in the formation of the design with the burin.

To a large extent, however, steel has been discarded as an engraving plate, since it has become possible to deposit a hardening steel face on to a copperplate after engraving.

Examples of the 'quality' attainable are best seen in heraldic bookplates, which are frequently done in this medium, an advantage being that an almost unlimited number of copies may be printed direct from the plate without fear of deterioration even of the finest lines. The transferring of the design to the steel blank and the engraving and printing are all carried

out in the same way as for copper, the only difference being that after the plate has been completely cut it is hardened before it is finally used for printing. Proof impressions may, of course, be taken during the process of finishing the engraving without fear of injury to the plate.

DIE-SINKING

The characteristic of die-stamping is that the design is raised up in the material stamped so that a relief impression is formed. This relief may be either plain and uncoloured ('blind', as it is called), or ink may be filled into the die and the surface wiped, in which case a coloured relief is formed on an uncoloured ground.

Stamping is done from a die which is engraved or 'sunk' in steel.

There is a certain similarity between die-sinking and steel-engraving, but the fundamental difference is in the method of taking the impressions and in the consequent thickness of the steel. Whereas a steel-engraving is printed in a roller press (the pressure passing slowly across the face of the plate), a die is printed by a hammerlike stroke over the whole surface at once. This method of taking copies limits the area of work done in one stamping, because the total amount of pressure which has to be exerted simultaneously over background as well as design would, on a large die, amount to many tons. The largest die catered for in printing is approximately 8 square inches, i.e. about 4" by 2", or 6" by 1½".

A soft steel blank of suitable size is first obtained (40). This has a round dowel peg on its reverse side for positioning in the press. It is approximately ½" thick. The face is polished, and on to this must be transferred a key in the manner described under copperplate engraving. If the design is very intricate and



40. The steel blank for die-sinking.

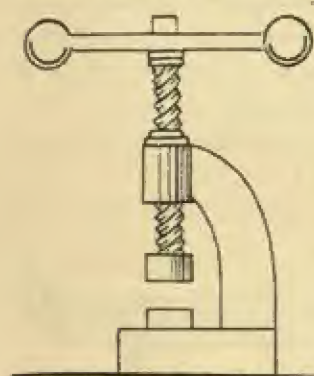
small, it can be photographically printed on to the steel instead.

The cutting of the steel die is done with burins similar to those for steel-plate engraving, but with slightly rounded noses. The metal is recessed more gradually, because when the paper is forced up into the recesses of the die, if the relief were too sudden, there would be a tendency to burst the paper at the edges of the relief. It is only on the wider surfaces that this applies; fine lines can be cut sheer as on a steel plate, for the paper will not be forced deeply into them.

It is possible to stamp an appreciably wide surface of colour, but it is usual in this case to cross-score the bottom of the area after it is engraved. This causes colour to be more readily held in the die when it is brushed on, before taking the impressions. When all the work is cut and a proof-stamping has shown all to be satisfactory, the die is sent away to be hardened, and is then ready for use.

STAMPING FROM THE DIE

The first step in stamping is to fix the die in the base-plate of a die-press (41). This press is a heavily made affair formed from an iron casting in horseshoe shape.



41. The die-press.

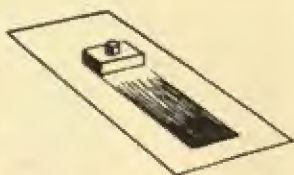
The die is held on the lower arm, and through the other arm is set a strong screw of very coarse thread. On the Upper end of this screw a crossbar with heavy cast-iron ball weights on the extremities provides the momentum for the impression stroke; on the lower end of this screw is a flat steel plate on which a gutta-percha male counterpart to the die is formed to force the paper into the recesses of the die.

The peg of the die is set in a recess in the base, so that it can

be lifted in and out readily without altering its exact position. To form the necessary counterpart, a piece of sheet gutta-percha is warmed and stuck on to the under surface of the opposing plate forming the base of the screw. While the gutta-percha is still warm it is brought down firmly on to the die with a sheet of tissue paper between to prevent sticking; the screw is fixed down for a short while until the counterpart is set hard.

A soft form of stencil brush is used for applying the colour, which is of a creamy consistency. Oil-colour or printers' ink reduced with varnish will do, or one can buy special die-stamping ink.

The colour is worked into the brush on a palette. The die is lifted out with the left hand, colour is brushed on its face, then with a



42. Method of wiping.

a firm, decisive thrust, the spare colour is wiped off its face on the top sheet of a pad of slightly rough paper (42).

This method of wiping is made possible by the complete rigidity of the die, and is, of course, far quicker than wiping by hand. This also affects the characteristic quality of design for die-sinking, because in wiping off the flat surface of the steel die against a hard flat surface of paper there is no difficulty in comparatively large areas of solid colour being retained in the die for transfer to the paper.

The die is then set back in the press: the piece of paper to be stamped is placed in position, and with a firm swing the weighted crossbar is given a half-revolution, which causes the counterpart to strike the paper into the die and make the impression, picking out the colour as it does so.

The copies must be laid out to dry, as the thick coating of colour will require some time.

Paper may, of course, be stamped without any colour being used, and this is called 'blind' stamping. The effect of this is similar to a medal or coin, and is used for company seals.

In blind stamping, modelling of areas below the surface is reproduced in the finest detail, but when the die is coloured, all areas below the face have uniform strength of colour. There is no gradation of tone, and shadows of delicate relief are largely obscured by the colour.

(C) STENCILLING

This process is probably one of the oldest methods of duplicating a design. The principle is that of merely cutting holes in some form of protecting sheet, and then brushing colour through these holes on to a surface beneath.



43. A stencil with colour shapes cut out.

The process is used in its simplest form for the marking of packing cases and is entirely a hand process. It may be practised by the artist himself, but is more usually carried out in the factory.

Stencilling on paper for book illustrations and so on has been carried to a very high pitch of execution in recent years.

CUTTING THE STENCIL

The cutting of the stencil itself is the first operation. Thin sheets of copper or zinc are principally used on the Continent, and the metal is two- or three-thousandths of an inch in thickness. Thin sheets of fresh celluloid also are very satisfactory, being easy to cut and clean to work.

The design must be analysed into a series of 'workings' and a stencil cut for each. Illustration (43) shows a comparatively simple stencil: the black represents the stencil and the white the portions cut away.

A tracing must be made for each stencil, and this must then be pasted to the material on which the stencil is to be cut. Paste must be applied to the latter, and not to the paper tracing, for this will stretch. The paste must be of firm and not of wet consistency for the same reason.

It will soon become obvious that there are limits to the number and size of holes which can be cut in a stencil sheet without its falling to pieces. When a great deal is cut away, the stencil becomes a mere filigree and, as such, it may not be able to stand up to the working of a stencil brush over it.

Beyond this it must be clear that if a large hole representing, for instance, a blue sky is cut out, a white moon in the sky will be left unprotected.



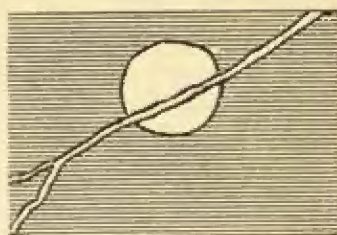
44- Crossed lines in stencil design.

It therefore frequently becomes necessary to cut two different stencils for the application of one and the same colour. Crossed lines in the same colour, similar to those shown in mono-

chrome in (44), would need to be worked with two stencils, for each line is a slit, and if they were all cut on the same stencil, the enclosed squares would fall away. The artist may therefore

find he can obtain both advantage and economy by crossing, instead, lines in one colour with lines in another.

Reverting to the example of the white moon on a blue sky, it might be supposed that this could be made better for the stenciller if a thin branch of a tree were brought over the moon, thus providing a 'tie' (45). In fact, however, such a slender



45. A 'tie' across the moon.

tie might not have the stability to hold the piece of stencil covering the moon in position, and in practice the sky would, even so, have to be worked with two stencils (46). In this example the two parts, when brought together, will form a complete circle.

When this is done, each half of the sky must be so cut that the line where the two parts meet is not noticed when the prints are finally coloured. The line is accordingly placed in such a way as shown, to disguise as far as possible the join between the two workings. Often it can be taken along some convenient line of the key drawing, as, for example, the branch in such a case as shown at (45).



46. Two stencils for the sky.

In the event of such a double working being necessary, it is an advantage if well-sized paper can be used, as the colour applied to such paper does not sink in and form a hard edge, as is apt to happen with less-sized paper.

The actual cutting is best done with a finely-pointed knife in a round holder. A Japanese wood-block knife (16) serves well. It is best to cut on a sheet of plate glass, and medium as well as fine oil-stones are needed to keep the knife very sharp.

MAKING THE COPIES

When all the stencils are cut, the colouring is proceeded with. Ordinary tube water-colour or gouache colour is principally used, according to the nature of the original. Coloured inks also are suitable. Sufficient colour must be mixed for the whole number of copies to be made, for to run short of colour in the middle of a working and have to re-mix a difficult shade is most inconvenient. The colour is mixed in a jar to such a strength that when brushed over the paper sparsely it will give the required tone.

The colour is kept stirred with a small paint-brush, and a few drops are transferred to a saucer as each copy is made. This small and uniform ration of colour is picked up with the stencil brush and applied through the stencil to the paper. The stencil is lifted and the coloured copy is removed from under it, and laid out to dry.

Considerable care and practice are required to produce an exactly uniform result in each copy, and with this practice it becomes possible to give slight variations of colour strength in the one stencil, to suit the requirements of the design.

From the palest tint of water-colour to the full thick strength of gouache great range of tone is possible. Sequence of workings must, however, be thought out so that the brush, in applying one colour, does not rub up the previous one where they overlap.

The chief attractions of this process lie in the purity of colour tints obtainable with water-colour, and in the subtlety of the brushing. When using gouache the direction of the brushing can be utilized as texture.

The designer should bear in mind that the colour shapes will be cut, and if he keeps this end in view it must lead to a satisfactory and a 'stencilly' result. At the same time, too close a consideration of technicalities should not be allowed to hamper the designer.

Examples of stencilled book illustration in different manners

will be found in Arnold Bennett's *Elsie and The Child*, illustrated by E. McKnight Kauffer (Cassell, 1929), and in Aldous Huxley's *Holy Face*, illustrated by Albert Rutherston (Fleuron, 1929).

THE SELECTASINE PROCESS

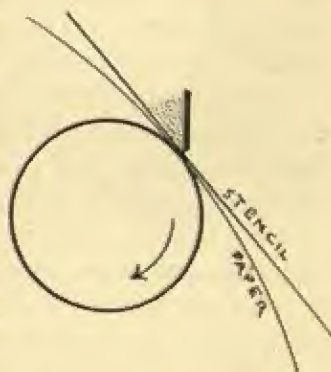
This process has no relation to others in its technique, but as it is a kind of stencilling it may be most suitably mentioned here.

Selectasine is best suited to showcards of very bold design, and the process must be considered carefully to obtain the best results from it.

It is in principle akin to the wax stencil process for the duplication of typewritten letters. A sheet of fabric ready impregnated with wax is the basis, and one sheet is used for each colour of the design. The wax filling is removed from the fabric following the shape of the colour to be worked, and a stencil is thus formed.

This stencil is set in a special machine, and a thick form of colour is squeezeed through it on to the paper (47), each succeeding colour being worked in the same way. The colour is so thick that overprinting of one colour on another is not effective, but a certain amount of very broad cross-hatching is practicable, and might usefully be employed. The colour surfaces are quite flat in tone and, because of the opacity of the pigment used, light colours can be worked on dark paper without loss of tone.

A very simple form of design which may easily be traced without loss of effect is the most suitable. Most of the work done is in very bold colour, that being the special forte of the process, but there is also scope for delicate colour schemes in bold design.



47. Diagram of the machine.

(D) LITHOGRAPHY

We have seen the principle of relief printing as instanced by wood-engraving, and of intaglio as instanced by copper engraving, etching, etc., and we now come to lithography, which is the most used form of planographic printing.

Lithography is nowadays in the toils of the camera, but it is the more natural use of the original stone method that this book is first considering, because of its crisper vigour.

In the first place the process has evolved from the natural antipathy of grease to water. The basis of work is a particular form of limestone known as lithographic stone. This is of various grades and is sold by weight (48).



48. A lithographic stone.

The best grade of lithographic stone is of a slaty-grey colour, both fine in texture and free from blemishes. This stone has a disadvantage, however, for its dark colour makes it difficult to see exactly the drawing put upon it.

The next best quality is a yellower, paler stone. It is cheaper and more usual than the grey stone mentioned above. As the price goes down, however, the stone is liable to flaws of two kinds. If the stone, when polished, shows whitish speckling or rash on its face, this is caused by particles of chalk or softer stone, and these are apt to break or etch away in use. The other blemish is in the form of crystal veins or sometimes fossils of shells set in crystal. This glassy substance is not affected by acid and so will remain high and probably print. Stones with a fine, clear and even surface, therefore, must be chosen for the work. It is best to see them polished and wetted before selecting, as this shows up any blemishes.

Finally, care must be taken that the stones are exactly flat on both sides, and quite even in thickness at all four corners,

in fact, quite even all over. A stone that is hollow on the under-side will break under pressure.

Thin stones are frequently cemented together to make up a workable thickness. This, if well done, is no detriment, and such stones are much cheaper.

MATERIALS REQUIRED¹

GUM (acid). A solution of gum arabic and water is mixed and strained, then parted off into two jars. This should not be watery, but stiffish, like warm treacle. To one of these a few drops of nitric acid are added, sufficient to show a slight bubbling activity when a spot is put on a corner of the stone.

GUM (plain). The other jar mentioned above is kept without acid in it.

FRENCH CHALK (powdered). Obtainable at a chemist's.

RESIN POWDER. Obtainable at a chemist's.

NITRIC ACID AND WATER. A weak solution sufficient to show marked activity when a spot is tested on a corner of the stone.

WIDE CAMEL HAIR BRUSH. About 3" wide.

TURPS (pure).

ASPHALTUM WASH-OUT SOLUTION. Obtainable ready for use from supply houses.

INK, ROLLER AND SLAB. A litho hand roller is covered with a special leather having a nap surface, and can be bought ready for use, as can also the 'rolling-up' ink. For slab, an old litho stone is usually employed (49).

FAN (described later).

CHEESE CLOTH. Clean and free from hard substances.



49. Hand roller and stone ink-slab.

¹ All materials and apparatus used in lithography can be had from L. Cornelissen & Son, 22 Great Queen Street, W.C.2, or from Hunter, Penrose Ltd., 109 Farringdon Road, E.C.1.

SPONGE. Two small fine-textured Turkish sponges, from the chemist's.

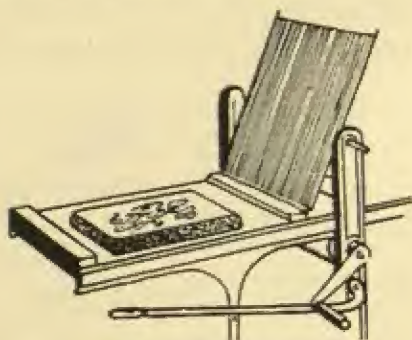
BLOTTING PAPER. Some large sheets.

FLANNEL. Several small pieces.

PRESS. Of size to take largest stones to be worked.

THE LITHOGRAPHIC PRESS

Briefly described, the lithographic press has a fixed, leather-covered, hardwood 'scraper', with a travelling bed to carry the stone under it. To this bed is hinged a zinc cover or tympan that is greased on its outer surface to annul the dragging action



50. The lithographic press.

of the scraper as the stone passes under it in printing. The essential parts only of the press are shown (50).

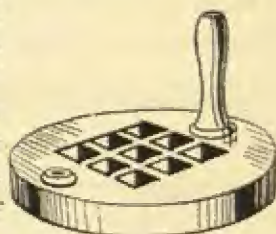
A sheet of the paper to be printed is laid in position on the inked stone, with a sheet or two of soft paper upon it. The hinged tympan is then brought down on to the stone, and the cranked handle of the press is turned until the first edge of stone comes under the scraper. The pressure-lever is then put down, and this lifts the stone up to the scraper. The scraper is mounted on a strong screw, enabling it to be regulated in height, and this is now used to set the scraper at the right pressure, the pressure-lever being released temporarily again for this purpose.

When set, the stone is turned once through, so that the scraper applies pressure to the entire length of the design. The pressure-handle of the press is raised, and the bed is pulled back to its original position, the scraper screw being left as it is. The back of the tympan or metal sheet on which the scraper presses must occasionally be lubricated with tallow, and great care must be exercised that this does not get about on the stone.

The amount of pressure which can be given without breaking a stone can only be ascertained in practice, but a good deal is required, according to the hardness of the paper. It is often necessary to use the whole of one's weight to force down the pressure lever.

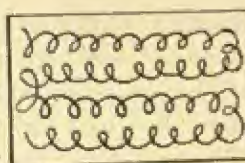
PREPARING THE STONE

The first step is to prepare the surface of the stone to the required degree of grain or polish, and to absolute freedom from grease. This is done by grinding it with another, smaller piece of stone, or with a specially-made iron 'levigator' (51), a round, flat cheese-like affair with a handle fixed freely on a spindle at one side of the top. The grinding is carried out with water, and sand of varying degrees of fineness.



51. Iron levigator.

It is usual to obtain sieves of varying mesh wire gauge, 40, 60, 80, or 100 wires to the inch. The sand is sprinkled over the stone from one of these sieves according to the grain required. Water is then added and the levigator rotated by the handle with a swinging action. It is worked evenly and regularly over the whole surface, either until the previous work on the stone has disappeared or until an even texture is produced. It is very important to work systematically



52. Work thus in both directions.

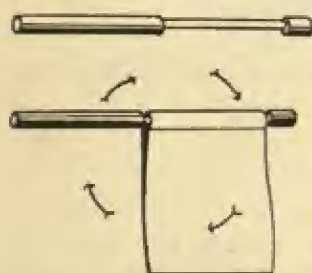
over the whole stone in both directions (52), whether there is work to be removed or not, or an uneven thickness will result.

If a specially fine texture is required, a small marble or stone muller (53) may be used in the two hands, and worked over the surface of the stone with fine sand and with a similar rotary motion. This may also be used on only part of the surface, where the design requires a smoother grain.



53. Marble muller.

The sand is then washed off with a small hosepipe, and the stone is dried, first with a very clean piece of cheese cloth and later with a fan. This latter is a flag-like tool made from a stick and a folded length of millboard, and looks, when made, like the illustration (54). When rotated with a circular movement it gives an effective draught.



54. The fan.

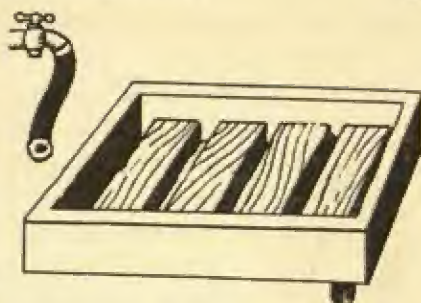
From all this it will be seen that a drained trough (55) with wood supports is required for the stone. Water must be laid on with tap and hose well above the trough. As sand will be constantly washed down the drain, some form of settlement or trap is required or the drain will become clogged.

When the stone is dry it is ready to receive the drawing. Some slight preliminary sketching may be done with a light coloured, non-greasy crayon, but this must be done very lightly or the crayon substance will clog the lithographic chalk when the work is put on the stone afterwards.

The design is now put on the clean stone in black grease, and it is well to emphasize at the outset that, for the purpose of technicality, grease, though it may be entirely invisible, will still print when the time comes. The hand, for example, is capable of producing a fingerprint all too readily (*see 57, h*).

Great care must therefore be taken that only the grease required gets on the stone. Black pigment is put into the grease merely to show what is being done.

55. The wooden trough with hose and drain outlet.



DRAWING ON THE STONE

Three full-page 'samplers' of lithographic drawing are included.

The first (56) is on grained stone. At A the drawing is with crayon and fine white lines are formed by subsequent scratching with a needle or knife point. At B and C respectively drawing is with hard and soft crayon, aiming at a light and heavy result. At D the side of a piece of square crayon has been used.

The second 'sampler' (57) is on polished stone worked at E with a steel pen and at F with a brush. At G portions were stopped out with gum and when dry the ground was spattered with lithographic ink from a tooth-brush. At H ink has been dabbed on to the stone with a fine textured sponge and with finger tips.

The third (64) at I shows crayon, pen and brush all used together, and below, J, the effect of transferring grease to stone from various rough fabrics; in the last case over gummed-out leaf shapes.

DRAWING WITH CRAYON

Litho crayon is obtainable in the form of pencils or in round or square sticks (58) used with a holder. It is made in several grades of hardness. A special holder can be made to grip the crayon lengthwise if wide strokes are wanted (59).

The design must be drawn on the stone just as it is to print, but it must be remembered that the 58. Square litho-work must be wrong way round, as for engraving. graphic crayon. For fine work the crayon must be constantly sharpened with a



knife or by rubbing on sandpaper with a twist and thrust movement of the fingers.

When all the details of the design are put on the stone, and if it is intended to draw on further stones for additional colour printing, it is well to add 'register' or guide marks (60) at top and bottom in lithographic ink with a ruling-pen. These must be repeated on each stone, and will make a ready means of fitting the colours exactly in position on one another when proofing.



59. A Broadway holder.

It is well also to draw, in lithographic ink, solid rectangles which will print in successive positions along the margin of the paper and show the colours used in their full strengths (61). All these marks will trim off when the print is complete, but will be very useful in proof stage.



60. Register marks.

After completing the drawing, the stone should stand with clean paper over it for twelve or more hours, to allow the grease of the crayon to penetrate the stone. It is then ready for fixing treatment, which will make it possible to print copies, for without fixing the grease upon the stone and rendering the remainder of the stone unreceptive of grease, the stone could not give an appreciable number of copies without deteriorating.



61. Successive rectangles of colour.

This treatment will seem rather complex when put into words, but when mastered, the materials all being to hand, it is easy enough.

OPERATION FOR CRAYON-DRAWN STONE

OPERATION

Some acid gum solution is swilled over the stone, and the flow is assisted with the soft wide camel-hair

EFFECT

The acid decomposes the soap and liberates the grease from the crayon.

A *scratch*



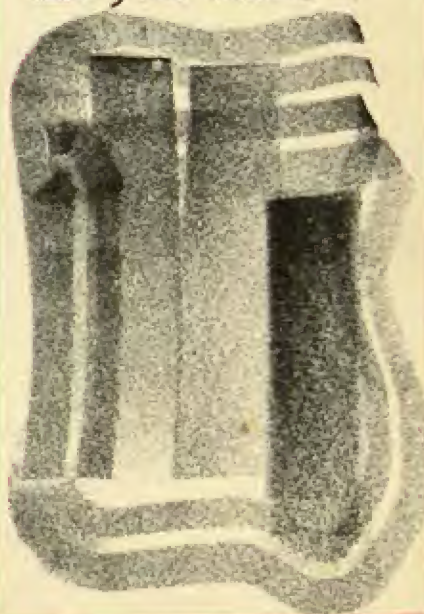
B *fine chalk*



C *heavy chalk*



D *flat chalk*



OPERATION

brush, or with a fine sponge, the stronger parts of drawing being given extra attention. The stone is then blotted and dried.

When quite dry, it is washed off with plenty of clean water, and the stone re-gummed with plain gum and a soft sponge. It is worked out thin and completely dried again.

This is washed off and the stone wiped with clean soft cheese cloth until it is damp only—no standing water.

The stone is rolled up with black ink worked out first to a thin film on roller and slab. There must not be too much ink on the roller or the work will become clogged and coarse, but all the detail of drawing must become inked. If the background begins to take ink before all the work is covered, wipe over with the damp cheese cloth and roll again. The stone must be dried once more.

It is dusted with powdered resin and then with french chalk applied with flannel, and surplus removed.

It is then etched with nitric acid and water applied with camel-hair brush, more in strong parts of design, less where work is delicate. Half a minute or so is enough, when this must be washed off.

EFFECT

The gum prevents the grease from spreading.

This seals the surface of the stone where it is not covered by the crayon.

The damp stone of the background will not receive ink.

The ink will gradually pick up on the work. Patience is required to feed the ink slowly enough at this stage. Much rolling with a sparsely inked roller will alone give the sparkle which the artist intended in the work.

The resin and chalk form an acid-resist.

This gives the 'work' on the stone an imperceptible relief.

OPERATION

The stone is gummed with plain gum, worked out thin with sponge, and dried.

Leaving the gum on, it is washed with pure turps on flannel and fanned dry.

Then it is washed out with asphaltum solution with flannel, wiped to a very thin film and dried.

It is next washed off with water and sponge, which also removes the gum, and is then left damp with cloth as before.

Finally, it is rolled up for printing in black or colour. The impression is taken in the press with a couple of sheets of plain paper behind the printing paper.

EFFECT

The dry gum film seals the background of the stone.

This removes the substance of the original crayon used in drawing.

This makes the image on the stone still more secure.

This finally leaves the stone ready for inking and printing.

DRAWING IN INK

As an alternative to the crayon, which is saponaceous in character, the design can be drawn with litho ink. This is obtained in sticks and is rubbed on a warmed saucer (62), then moistened with water, rubbed in with the finger. Such ink may be applied with a water-colour brush, with a pen, a ruling pen, sponge-brush, or in any other way.



62. Ink rubbed in a saucer.

Its pigment value is less than chalk, and care must therefore be taken not to misjudge the printing value of what is put on the stone. The slightest grease from the ink will print black, provided that it is not rubbed up with too much water, and that the stick of ink is not unduly old.

Such a stick should keep quite well in a tin for a year or more, but ink once rubbed up in a saucer with water should not

be re-wetted repeatedly. It is safest to rub up a fresh supply each day.

When the design has been put on the stone, work may be done with a sharp-pointed knife (63) to scrape away high-lights or to manipulate textures (56a), but care must be taken not to scrape too deeply, or the stone will require much grinding next time it is used. A heavy-handed old pocket knife with a broken blade that has been sharpened again like a chisel may



63. Lithographer's Knife.

be used with a jarring thrust to break up solids. As the knifing proceeds, the particles must be blown away with unmoistened lips, to assure their complete removal from the surface.

This knifing can be equally well done on a chalked stone, the thickness of chalk, however, is often considerable, and it must, therefore, not be smeared, but cut crisply and entirely removed, lest it fall on more delicate parts of the work and cause a blemish. The best angle for the knife can only be found with practice.

A stone prepared with ink requires different treatment from one drawn in chalk, and the mediums should therefore not be mixed.

OPERATION FOR INK-DRAWN STONE

OPERATION

EFFECT

The stone must be left standing, if possible, for a few hours, as with chalk-drawn stones.

This gives time for the grease to sink in.

Then it is gummed with plain gum solution, wiped out thin, and dried. There is less danger of smearing the work than with a thickly chalked stone.

This seals the uninked background of stone.

OPERATION

EFFECT

Gum is left on and the stone is washed with turps on a clean cloth and fanned dry.

This removes the substance of the ink drawn on to stone, but leaves the impression of grease on the stone.

Next, with the gum still protecting the background, it is rubbed with asphaltum solution, wiped to a very thin film, and dried.

This secures the image.

This is washed off with water and sponge, which will now remove the gum also, and the stone is left damp by the cloth.

The damp will reject the ink on the roller now to be used.

The stone is now rolled up with printing ink and fanned dry. It is then dusted with french chalk and the surplus removed.

This forms the acid-resist.

It must next be etched with nitric acid solution, with a very little gum in the sponge, for a few seconds, and washed off with water.

This secures the image still further.

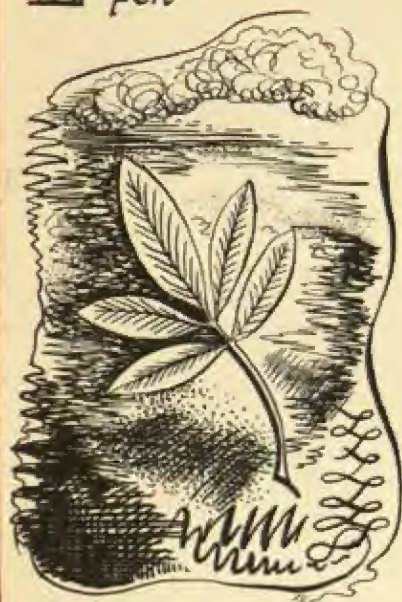
Then the stone is gummed and dried, and with the gum film still on, it is washed with a little turps on flannel. Finally it is damped with sponge and cloth and rolled up in black or colour and printed.

This again seals the background, and removes the substance of the resist, leaving the stone ready for printing.

POLISHED STONES

Drawing or painting with liquid grease may be done equally well on polished stones if a grain is not required, and the litho ink may be applied with a fine steel pen (57*e*). In this case,

E pen



F brush



G gum and spatter



H sponge and fingerprints



after grinding off the previous work with fine sand, the stone is polished with a bar of 'snake-stone' and water without sand, finishing if necessary with a piece of marble. Dense solids may be made with a brush (57*f*) or fine lines with a pen, and textures with a sponge-brush (57*h*), by sputtering (57*g*), or with a knife (56*a*).

OF TEXTURES IN GENERAL

It is possible to work over stencils of paper, applying ink with a sponge-brush, or in various other ways to obtain different textures. The air-brush, for instance, is a form of brush by which liquid colour is blown by compressed air through a nozzle. It is often used in the trade, the nozzle being set coarse, and held some way off to produce definite globules of ink.

The texture of canvas or of any material can be transferred to the stone, whether polished or grained (64*j*), by lightly inking a sheet of zinc laid over a stone with greasy ink; then the piece of canvas or other material is laid on it and pulled through the press. The material is peeled off, laid down on the stone, and pulled through the press again. Where the texture is not wanted, the surrounding stone must be covered by an accurately cut mask, or be painted out with gum and dried before the inked material is laid down.

The conventional way of blanking-out the parts of the stone which are to remain white is to pigment some thin gum solution slightly with water-colour, and to paint those portions with it—see leaf shapes on (57*g*) and (64*j*). When dry, the gum will have rendered those parts of the stone unreceptive to grease, so that they cannot afterwards be worked on without first being resensitized with nitric acid solution.

Another method of producing coarse texture on the stone, which has already been referred to, is to spatter it with a stencil-brush dipped in ink, flicked or stroked with a knife blade or piece of card (57*g*). This must first be tried out over a piece

of paper to obtain the right degree of stipple. Or ink may be dabbed on with a sponge (57*h*).

In many ways a slightly grained stone worked on with ink offers greater scope than does the grained stone worked on with chalk.

VITALITY OF LITHO

It has been assumed so far that the design is being originated straight on to the stone without more than a preliminary rough on paper. This is unquestionably how the first work should be carried out, for the method has its own qualities, and these are not developed at all unless they are procured directly in the medium itself. It is owing to this lack of direct work by the artist in the medium of lithography that lithography has lost its vitality as a process, and posters in this country have become

in consequence reproductions of oil- or water-colour, or flat gouache painting. Designers in this country are not as a rule aware of the many possibilities of actual work on the stone, a technique in which lithographic designs should be conceived.



65. Part of a key-drawing.

KEYING

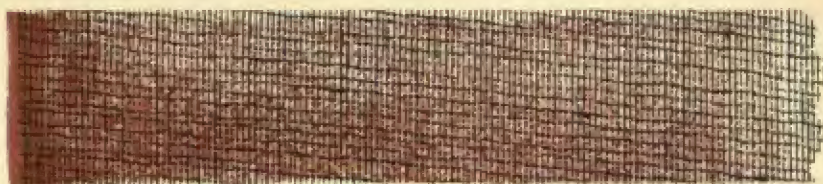
If several colours occur in a design and no one colour forms a complete guide to the whole, the design must be 'keyed' to a set of stones as follows.

The finished design must first be made on paper. This must then be traced, defining each patch of colour (65) with litho pen and ink on to a sheet of transparent 'transfer paper'. This tracing can be transferred to a stone. The stone is rolled up as already described, and impressions are then made from it—one

I *various direct techniques*



J *Transfers*



gum and transfer



for each colour. These are dusted over with powdered red ochre. The residue is flicked off and the sheet is pulled down on to a clean stone. When it is lifted, a removable guide line is left on the stone. One copy or 'set-off' is pulled down on to a fresh stone for each colour in the design.

For very fine work a sheet of gelatine may be used instead of transfer paper, and the key scratched lightly on it with a fine engraving needle. It is very necessary to emphasize that the key must be fine. Scratching or drawing twice over a line leads to indefiniteness in the finished key. When on small work certain colours have just to overlap one another and no more, a very exact guide is required. This gelatine key is inked with transfer ink softened with turpentine, wiped off like a copper engraving, and transferred face down to a litho stone. The image is then rolled up and set-offs pulled for transfer to the stones for the various colours, as with a paper key. The finest scratch will hold the colour; anything coarse renders it no better than a pen and paper tracing.

DRAWING ON TRANSFER PAPER

It is possible to carry out lithographic drawing with either crayon or brush on transfer paper, and this is very convenient for an artist who wishes to work in his own studio or in the open. Transfer paper is a paper coated with a suitable substance which prevents the greasy ink from soaking into the paper, and makes the grease pass easily on to the stone when transferred.

Chalk work and ink work should on no account be mixed in one job, for, in transferring from the paper, different treatment is required for the two kinds of grease.

An excellent paper for bold chalk drawing is 'J. P.' transfer paper, supplied by Cornelissen, and named after Joseph Pennell, for whom it was first made. It was used by him in his lithographs of the Panama Canal excavations.

Another good paper is Cornelissen's No. III_B, which has a coarse, egg-shell surface. These papers have a coating of

plaster-of-paris, size, and other ingredients. J. P. paper has a natural gritty surface akin to the surface of grained litho stone. Both may be knifed after drawing or painting. If the knife is used, however, care is required not to smear the ink. Only if the very slightest scraping is done, so that some of the coating still remains, is it possible to work with ink or chalk over the same place.

Such a transfer is put down to stone in two ways, according to whether it is made with crayon or with ink.

TRANSFERRING A CRAYON DRAWING

A crayon drawing, having a definite thickness of solid grease upon it, requires very careful handling, or the grease will spread under the action of the press, and the fine white specks of paper which show in the drawing and give life to the heavier parts will close up.

The stone must be prepared with a very slight grain and must be scrupulously clean and dry. In winter it may have the chill taken off by placing it in front of a fire, or by using a blow-lamp, but it must not be definitely warm. It may be warmed with hot water and then dried.

If the transfer has been drawn some weeks previously, it will be helpful to moisten the surface of the stone very slightly with pure, quite clean turps on a clean flannel, and let it dry.

The transfer is then laid face down on the stone in the press. A sheet of paper that has previously been damped with a weak solution of nitric acid is laid on the back of it. The acid liberates the soap from the crayon. A couple or more sheets of clean dry paper are laid over all, and the whole pulled through the press once under a firm pressure.

The cover sheets, and finally the transfer itself, are then peeled off the stone. The drawing will remain on the transfer paper, but a sufficient amount of grease from every particle will have been conveyed to the stone to produce a clean print.

The stone must now be covered with clean paper and left for twelve hours or so. It is then treated as for a chalk-drawn stone. This method has the advantage that the original drawing is preserved.

TRANSFERRING AN INK DRAWING

If the transfer has been drawn with ink, the treatment is more severe, and nothing of the transfer can remain afterwards, for there is less grease available on the drawing, and all of it must be conveyed to the stone.

The stone is prepared in the same way, and left damp, no turps being used. A slight grain or a smooth surface may be given according to the nature of the work. The transfer is then laid face down on the damp stone with a sheet of paper damped with clean water, and a couple of plain backing sheets over it. The whole is then pulled through the press and the transfer will adhere. The cover sheets are carefully removed, the back of the transfer is redamped with a sponge, and the cover sheets are laid back in position. Care must be taken not to shift the transfer itself. The stone then goes through the press a second time.

Then there follow about ten or twelve repetitions of the process of damping and pulling through the press. Halfway through, it is well to reverse the stone in the press, so that should there be any unevenness in the strength of pressure it will be counteracted. It is also well to watch carefully that the backing paper does not become creased through damp and handling, for a double pressure would be given to some part of the work if this should occur.

When the stone has been a sufficient number of times through the press, the back of the transfer paper will become soft with repeated damping.

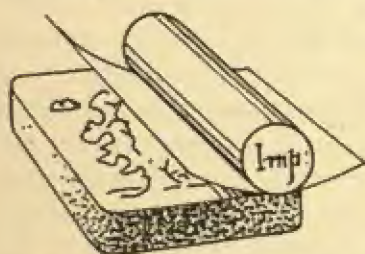
The transfer may then be wetted thoroughly, and gently rubbed away with the fingers, then finally stripped off. The stone is then washed lightly with a soft sponge and water, to

clean it from fragments of paper and coating. Next it is gummed up with acid-free gum, and treatment can be continued as for an ink-drawn stone.

This latter method would be used for the putting to stone of a pen key-drawing as previously described, except that the paper is of a thin transparent kind specially made for the purpose, and it will probably not require to go so many times through the press as would an original drawing.

One point to be remembered is that when working on paper the drawing must be made the right way round, so that it falls reversed on the stone, which may be considered an advantage.

A lithographic printing machine has a travelling bed on which the stone is laid and securely fixed. This bed is capable of being raised and lowered to bring the surface of a stone of

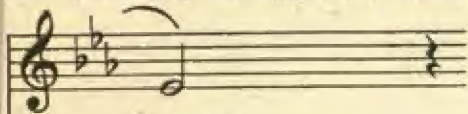


66. Principle of the direct lithographic printing machine.

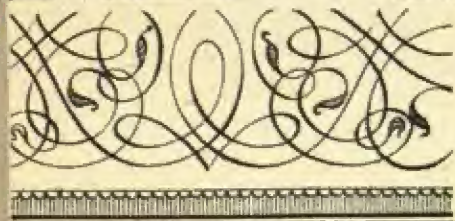
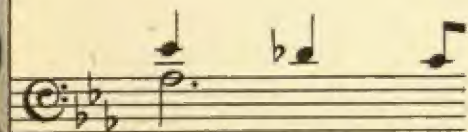
any thickness up to the uniform working level. The machine is provided with two sets of rollers: one for supplying ink to the stone, and the other for keeping it damp. A heavy cylinder for applying pressure is fixed centrally above the travel of this bed, and on this the sheet of printing paper is held during printing. There is also an iron slab fixed to the travelling bed for supplying ink to the appropriate rollers. There is a second cylinder which functions to remove the printed sheet and deposit it on a pile. The diagram (66) shows simply the impression cylinder pressing the paper to the stone.

OFFSET LITHO

Essentially, there is only this difference between offset and direct litho: in the offset printing machine an extra cylinder is added which is covered with a thin indiarubber blanket.



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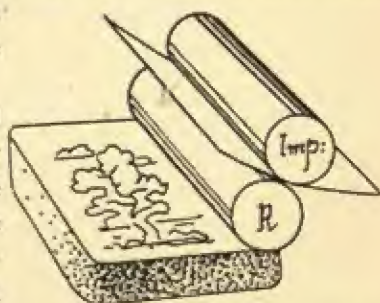


Printing first passes from the stone or zinc plate to this rubber blanket, and is taken from that by the paper. In the diagram (67) R is the rubber-clothed cylinder which has received the print from the stone, and the impression cylinder is seen pressing the paper to the rubber. This affects matters in several ways.

Firstly, the image on the stone is drawn the right way round instead of the reverse, or a transfer is drawn the wrong way round instead of the right.

Secondly, because of the gentle indiarubber pressure on the paper, only a very thin film of ink is required in printing. Thus, the sharp reproduction of even the finest hairline, as is obtained in copper engraving, together with full density of large solid surfaces, is possible. This result can be obtained on a rough surfaced paper and with light pressure, as will be seen from reference to the offset examples (68e) and (68f), which were printed together.

Through this precision and slickness, a chalk drawing printed by offset is apt to lose a little of its 'life', more particularly if a hard hand-made paper is used. The ink film is inevitably thinner, causing the dense parts to



67. Principle of the offset lithographic machine.

look a little flat. The surface of the paper makes it difficult for the work to be kept open, because the rubber enters all the little roughnesses on the paper and often disguises the small points of light left by the crayon on the original surface of the drawing.

Because of the thinness of the ink film a matt surface on the printing ink is more possible than in direct lithography, and any texture the paper may have is unchanged by the gentle pressure of the rubber blanket, whereas in direct lithography strong pressure on the hard stone surface tends to flatten the paper.

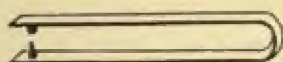
LITHOGRAPHY FROM ZINC PLATES

Although stone remains the most versatile and attractive surface on which to draw, most work is now printed from zinc sheets. The work is either drawn on them or transferred to them. In this case a thin sheet of zinc is ground in a special machine with glass marbles, sand and water, so that it is given a surface capable of holding both grease and water. The treatment is much the same as when working on stone, but it is not so easily controlled. Printing from zinc need not be more fully described here, as it is a matter principally of convenience to the printer.

Offset printing is nowadays mostly done on rotary machines, which work very smoothly with a continuous action. The advent of the thin zinc printing plate has made it possible for the plate to be bent round the surface of a cylinder, so that the reciprocating movement of the lithographic machine is done away with. There are three principal cylinders in this type of machine. No. 1 holds the printing plate clamped and stretched on its surface. Inking and damping rollers operate on this cylinder. No. 2 cylinder, of the same circumference as No. 1, is covered with a rubber blanket which receives the printed image. No. 3 cylinder is of plain steel; on it the printing paper travels and is pressed by it on to the rubber blanket, so picking up the image on to the paper.

LITHO OFFSET ORDNANCE MAPS

In the printing of Ordnance Survey maps (68*a*), the whole drawing of the map, with its textures and ciphers, is cut by hand and burin on a large sheet of copper. Lettering is mostly tapped into the plate with steel punches and hammer as in music engraving, which see.



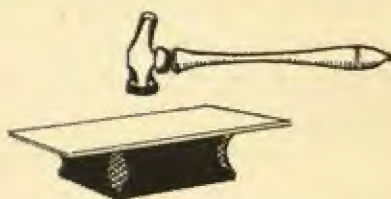
69. Engraver's correcting tongs.

The method has the great advantage of easy correction as topographical details change. The position of the correction is marked on the back of the plate with a special pair of tongs

which have a blunt point facing a sharp one (69). When the blunt point is at the position of the required correction on the face of the plate, the sharp point is used to mark the back. The plate is turned face down on to a burnished steel facing plate, and the copper is hammered from the back with a special round-faced hammer until the face is flat (70), when new work can be engraved upon it.

When engraving is complete, the plate is filled up with a special transfer ink of a greasy nature, wiped off and polished with whitening, after which a print is taken, constituting a lithographic transfer.

This is put down to a zinc plate or stone for printing in an offset lithographic machine.



70. Planishing with anvil and hammer.

OFFSET FROM DRYPOINT OR ENGRAVING

The process just described may very well be used for book illustration, as may be imagined from reference to examples on plate (68). Etching, copper engraving or Drypoint may all be transferred to zinc sheets. The wipe of the colour in an original drypoint print is, however, not rendered, nor is there any surface tint from an engraving so printed.

OFFSET LETTERHEADINGS

Many business letterheadings are engraved on copper plates and transferred to zinc machine plates for offset printing, and a few samples of such engraving are printed by offset on the sample sheet (68*d*). For these, the work is first sketched on paper, and then traced down on to a wax-grounded copper plate, using a blunt steel point like a fine knitting needle for marking out. The work must, of course, be the right way

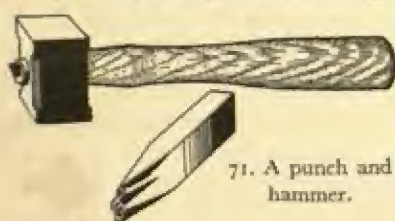
round on the copper, reading from left to right. The lettering, etc., is then engraved with burins much like those used in pictorial copperplate engraving.

In sketching, in the first place it must be borne in mind that the form and character of the lettering should be one which will come naturally to the burin. Much poor work is done through negligence of this point; in fact, there are very few copperplate lettering engravers who have taken the trouble to study fine lettering form, or to consider the natural inclination of their tools.

MUSIC PRINTING

Staff notation music was originally engraved in a manner somewhat similar to that just described. The engraving of the characters gave much grace and flow to the page, which looked rather like a pen-written manuscript, and was often embellished with decorations engraved in the same free manner.

Nowadays, for economy of time, all the characters, such as clefs, notes, rests, and lettering, are tapped into the plate with



71. A punch and hammer.

steel punches (71), and only the stems of notes, slurs, bar-lines, and the stave-lines themselves are actually engraved. A designer, therefore, who wishes to show a special form in any of the

characters, has to start by designing a set of steel punches.

The present conventional form is much more true to the steel punchcutter's technique. The characters are hard and formal, and grace is not often apparent in printed music. The fine hairlike finials and serifs characteristic of direct engraving would be neither suitable nor possible in steel punches, for the steel would wear away in use, and the characteristic detail would be lost; nor would such fineness be conducive to legibility. Grace is not impossible, as may be seen by

reference to the special punches designed by Paul Woodroffe for use in the music of the 'Curwen Edition' and to the music punches of the Oxford University Press.

The plates used are pewter, and about the same thickness as a copperplate. The work is first marked out on them with a blunt needle. The five lines of the score are then cut with a special multiple tool (72). Next the characters are punched and engraved, after which the surface is planished, by laying the back of the plate on an anvil and tapping the face with a polished hammer.



When the printing is to be done, the engraved pewter plates are filled with a greasy transfer ink, wiped off, and a set of transfers ^{72. Five-pointed tool.} is pulled in a copperplate printing press. These are then put down to a grained zinc machine printing plate, in much the same way as are the Ordnance Survey maps and letterheadings already described. An example is shown at (68c).

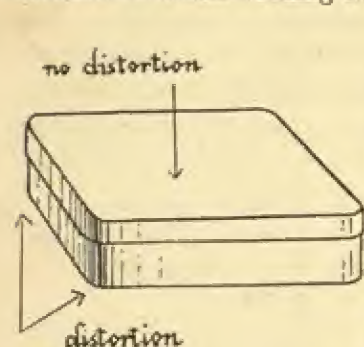
TIN-BOX PRINTING

This is done by offset lithography by a similar method to printing on paper, and, indeed, the idea of interposing the rubber cylinder used in offset lithography on paper originated from tin-printing machines. The rubber intermediary cylinder is essential in tin printing, because of the impossibility of printing from a stone or zinc surface direct on to a sheet of metal.

It is usual, although by no means necessary, for designs to cover the entire surface of the tin box with one colour, leaving no part of the bright silvery metal showing. If a light colour background is required with a darker design upon it, the tin is printed all over several times with a coating of light ink so as to render the background quite opaque.

After each printing the tin plates are 'stoved'—that is, they are hung in a room which is kept at a high temperature and ventilated with forced draughts to dry the ink.

Other colours are printed on top of this priming, and the effect then given, as far as the designer is concerned, is much the same as when working on paper, either white or toned.

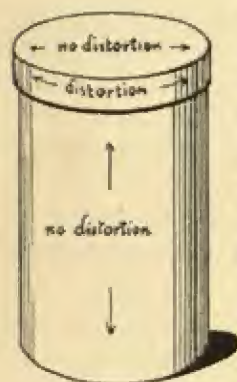


73. A tobacco tin is closed in at the corners.

If, for example, white lettering, a vermilion coat of arms, and a black ground are required on a tin, all the areas of white and vermilion must be printed two or three times with white. Then the vermilion is printed on the white in its place, and lastly the black ground is printed. Finally either a matt or shiny varnish, according to choice, is printed all over the tin to protect the printed colours from rubbing off through

the hard handling to which a tin box is usually subjected.

The tin is then formed in stamping presses, which make its shape, and, according to this shape, the metal is stretched or closed up so that there is inevitable distortion of the surface. This distortion is considerable, and allowance for it can only be made by the tin-box printer, who is able to test on his machines just where allowances are necessary. In a flat tin like that shown, the rounded corners of both lid and box would be contracted in stamping (73).



74. A cylindrical tin is wrapped. Only the edge of lid is compressed.

Because of this distortion, the designer who wishes his own drawing to be reproduced must keep to the parts which will not be stretched or compressed. Edges, and particularly corners, are best left to show the metal, or plainly coloured. In the case of this cylindrical tin (74), the edge of the

lid would be compressed all round, but not the top of the lid or the surface of the tin. In designing for the latter shape it must be remembered that not more than one-third of the circumference will be seen at one time.

Although edges and corners should be treated as simply as possible, yet quite delicate and elaborate work may be printed with considerable sharpness of detail on those parts of the tin which will not be distorted by the shaping. On such parts the tin-box printer can work direct from artist's black and white drawings.

It falls within the scope of the designer to control the finish of edges, which may be either cut, folded or rolled (75).

Every new shape and size, however, requires expensive tools for the forming presses, amounting, perhaps, to £100 for even a moderate sized tin of simple shape, and it is well, where possible, to consult with the maker so that the designer can work to sizes and shapes for which the necessary tools exist.



75. Cut, folded and rolled edges.

OFFSET WITH COLLOTYPE

Offset printing is used in conjunction with collotype printing to fill in flat colours that require no gradation of tone, because it is cheaper than collotype, and printing plates can be produced by drawing without the use of photographic methods. This is possible also because of the structural similarity of the machines, which makes the registering of colours between one machine and the other reliable.

PHOTO LITHO OFFSET

Under offset printing must be mentioned the very wide use made of 'photo litho offset'. As the name implies, this is printing by lithography via a rubber blanket, from printing surfaces prepared by photographic methods. Zinc plates, grained as

already described, are almost solely used for this work. The photographic methods used are nearly akin to those used in process engraving for letterpress printing, and it would be well if the reader were to study at this stage the section on Letterpress Line, Half-tone, and Colour Half-tone printing.

In photolithography, zinc machine plates, after graining, are coated with a bichromated emulsion on to which the design can be printed from a negative. This is, in effect, photographic transferring. The plate then goes through various simple treatments which make it ready for printing in an offset lithographic machine.

In making the negatives, it is possible to employ all the methods of photo process work. Fine pen drawings in indian ink can be photographed to plates and reduced in size (68e). Great sharpness is obtainable in this way. Such drawings can also be transposed to print in white on solid ground.

The half-tone screen, which breaks up a continuous tone subject, such as a wash drawing, pencil drawing, or photograph, into a series of minute dots of varying size, can be used (76), so can a mezzograph screen, which breaks up such an original into minute irregular dots or particles of varying size. The last named has not found scope commercially at present, because it gives less contrast than the ruled screen.

The drawback to the half-tone screen offset plate is that any final etching or working-up of the densities is impracticable. The individual dot of the half-tone image, once on the stone or zinc sheet, cannot be reduced in size by after treatment, as is done in the re-etching of half-tone blocks for letterpress printing.

All working-up of tones and highlights is accordingly done on the negatives before printing down to the zinc sheet. Stopping out of backgrounds to obtain a result similar to that of deep etching in half-tone letterpress blocks is also done at the negative stage by painting out the background with opaque pigment.

In offset printing a very thin film of ink is worked, and this



76. Photo offset half-tone reproduction of a photograph.

is inimical to dense blacks. Continuous-tone subjects are therefore usually 'flat' in effect, unless specially designed with excessive contrasts for the process.

Such coloured wash-subjects as water-colour or oil-paintings can be reproduced by the use of a half-tone screen and colour filters (127). (See chapter on Letterpress Colour Half-tone.) There is, however, a comparative lack of density in the colours printed, again owing to the very thin film of ink used, and to overcome this a certain number of extra plates have to be worked to supplement the stronger parts of the design.

The method could give interesting results if an artist would prepare a series of tone drawings in black and grey washes from which to make the negatives. These will be printed in correlation to one another in their respective colours. It cannot be too often repeated that printing is a series of impressions in a controlled sequence of colours. Designs should be prepared with this in mind rather than with a wide palette of colours for separation by the ingenious colour filter method. Thus, for example, a black wash drawing may be prepared for printing in sepia, and a second black wash drawing may be made for printing in, say, a tint over the first printing to complete the design. The result achieved in two printings may well be more effective than the technically more skilful reproduction in many printings of a fulsome water-colour painting.

This general idea of a series of colours does not limit the range of application. It can be used in formal as well as in free methods of design, and even with photographic originals of the most impressionistic kind. Too much is usually left to the mechanics of reproduction.

Nor is this an expensive method, as is the use of colour filters, for, when these are used, at least two supplementary printings are usually required in addition to the three primaries. For the same outlay of money there can be at least six printings by the method described.

It will therefore be seen that lithography has wide scope for

any artist who cares to make a comprehensive study of the process at first hand, and such study is likely to lead to the most logically sound designs and prints, for whatever purpose the design is made.

PART II

PHOTOGRAPHIC REPRODUCTION

Under this general head come practically all the rest of the methods of reproduction used in the printing crafts. Each may be used in one colour only, or in many, and one process may sometimes be used in conjunction with another.

(A) LINE METHODS

DRAWING FOR LINE BLOCKS WITH PEN AND BRUSH

First comes the simple 'line block', or relief zinc printing block etched through a photographic acid-resist. This may be made from any subject that is entirely free from gradation of tone (77). Such a plate, when made, is mounted type-high (the height of a shilling) (78) and printed like a wood-engraving in a letterpress machine. This machine is described fully on a later page.



77. A pen drawing for line block reproduction.

In the following pages it is assumed in all cases that the artist wishes to make his own working drawings. To enable this to be done, a brief list of the principal materials and tools required is here given:¹

A drawing board

T-square and set-square

¹ All these, and many other useful materials, are supplied by Messrs. L. Cornelissen & Sons, 22 Great Queen Street, W.C.2.

Bristol-board (smooth or matt surfaced)

Thin Whatman paper or other well-sized *white* paper

Scraper-board (various surfaces)

Lithographic transfer paper, IIIb or IIIA

Higgins's Waterproof Black

Black body colour paint

Process white paint

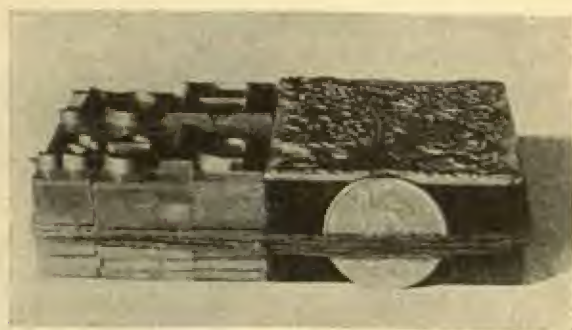
Black crayon, Venus 53 or Hardtmuth 'Negro'

Pens, brushes

Pumice powder

A tracing frame (described on pages 96-97).

It will be easier to understand the following notes on working drawings if a brief general description of the block making



78. The block mounted type-high for printing with type.

process is given at this stage, though this will be more fully described later.

From a black-and-white drawing a photographic negative is made, which must be perfectly clear and sharp. The white paper of the original will throw light on to the plate and render all that part of the negative an intense black, but where the black work of the drawing falls in image on the plate the emulsion will be quite unchanged, and after development this part will be like clear glass. A 'light stencil' is, in fact, made.

This is then printed in positive on to a sensitized sheet of zinc and an acid-resist is thus formed. The plate is then etched, so that all the background represented by white paper in the original is eaten away to a lower level.

The negative is made to exactly the size the finished block is to be, which may be either a reduction or an enlargement. The former is more usual. Blocks, the same size as original, reproduce the quality of the artist's line in its true scale, and are therefore the only kind that can be considered as comparable to the more intimate processes so far dealt with. Photographically speaking, however, reductions may be made to any extent.

It is well to remember, when intentionally working for



BY APPOINTMENT



BY APPOINTMENT

79. A drawing reproduced in full size and also in two reductions for comparison.

great reduction in size, that the appearance of the drawing and composition alters with its size (79). When drawings are being made for reduction, cross-hatchings should be kept open and at definite angles. Straight-hatchings at as many as eight angles over one another will keep open in reproduction, whereas lines cribbled in the same directions become clogged. Some varied textures are shown as drawn, and reduced to one-third length (80). The quality of the line is reduced in scale, and, with too

great a reduction, what was in the original actually drawn by a human hand may in the block seem to have no character or quality at all.

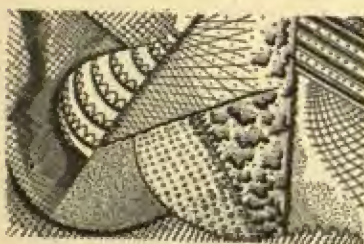
Where a slight sharpening of the result is wanted, a drawing is frequently made one-third longer each way than the finished size of the block.

In this matter of scale reduction it may be well to include the often-repeated formula diagram which shows that any two rectangles having their corners on a common diagonal are uniform in proportion (81).

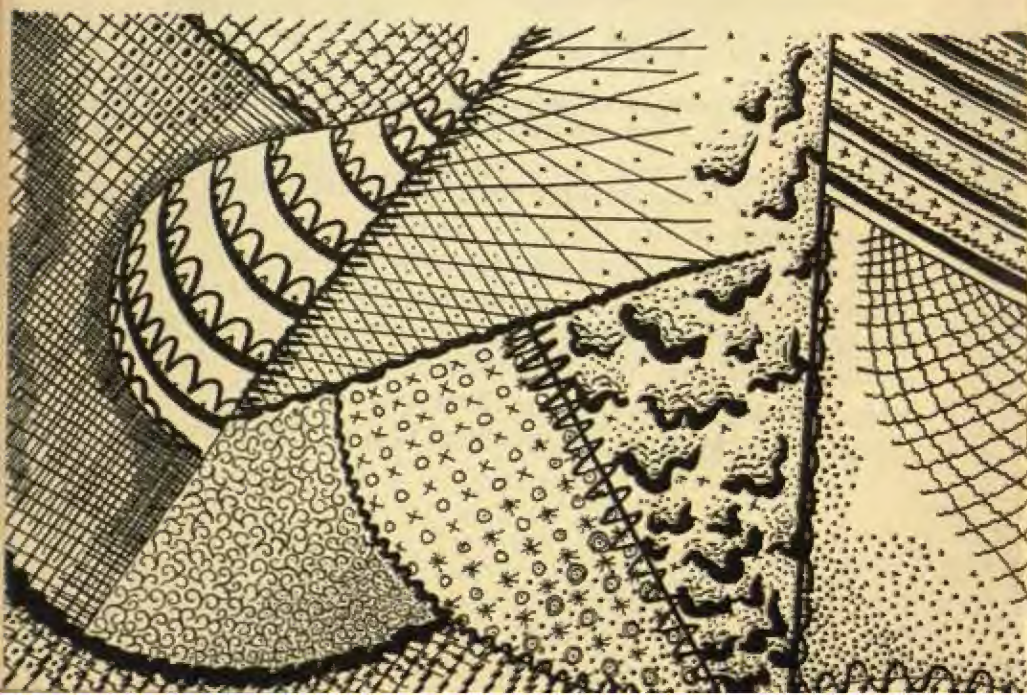
Sizes are stated by length one way, and the other measurement will automatically be in proportion. It is confusing to

describe a reduction to 'half length' as 'quarter size', though it would in fact be that.

In order to get the perfect stencil-like contrast in the negative it is of the greatest importance that the drawing should be made on a really white paper or Bristol-board.



80. The textures as drawn below are here reduced for comparison.

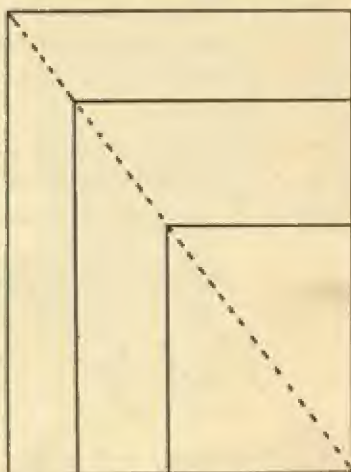


Drawings on toned or tinted papers require special photographic plates and special treatment throughout the block-making. This costs more money and endangers the result.

The ink used should be dense black in every part, even in the finest lines. With a pen, Higgins's Waterproof Black is the best to use; with a brush, body-colour black is better. Writing ink from a fountain pen is of no use at all for the purpose.

Sometimes, as will be mentioned later, tracing paper may be used for drawing on, but a tracing of a bluish shade should be selected, for blue is seen by the camera as white. A yellowish tracing paper will photograph as a grey. On tracing paper, however, owing to its somewhat greasy nature, ink is apt to work thinly, and this must be carefully avoided. If this trouble occurs, tracing or any other paper may be 'pounced' by rubbing with pumice powder.

For preliminary sketching or plotting out, it is best to use a clear blue crayon lightly, and this need not be rubbed out, as it will not photograph. If pencil is used, it must be rubbed away when the drawing is completed, or its grey tones will confuse the photographic plate.



81. Three rectangles of the same proportion.

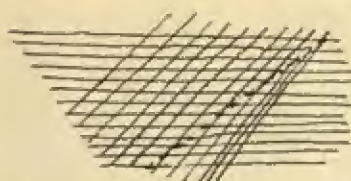
ALTERATIONS ON DRAWINGS

If anything is to be corrected, 'process' white must be used, not Chinese white, as the latter, though appearing white to the eye, appears grey to the photographic plate. Process white appears white to the camera, but it has the disadvantage of turning brown some months after use. Therefore, if the drawing

has value as an original after use by the block maker, it is better not to use either, but to make the drawing carefully. In case it may be necessary to use process white on a drawing, it is of course important to use waterproof indian ink to prevent the black working-up into it later.

Erasure is also dangerous, for it almost inevitably leaves ragged edges and roughs up the surface of the paper, which roughness will throw shadows on what should show clear white to the camera.

Patches, if they have to be resorted to, must be on thinnish paper, or their edges will throw shadows in photographing, and these will come out as lines in the block. If such edges pass through cross-hatchings, they are difficult for the block maker to engrave away. The join in this hatching is easily discernible. It has purposely been none too carefully made (82).



82. The edge of a patch passing through a cross-hatching.

For the same reason a rough paper is not good, although for special purposes it may be necessary. For pen work, white Bristol-board is the ideal material from the block maker's point of view, but any paper may be used that is white and well sized, so that its surface is firm and does not play undesirable tricks with the nib.

DRAWING FOR LINE BLOCKS ON SCRAPER-BOARD

There is a special board, sold under the name of 'Scraper-Board', which is worth mentioning because of its great convenience. This is a board coated with a thick layer of china clay and size, on which it is easy to draw or paint with indian ink, and which can be knifed away afterwards. A very sharp-pointed knife should be kept specially for the purpose, or a drypoint needle may be used.



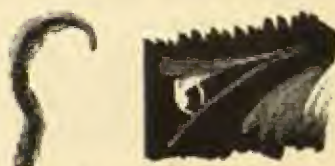
83a. Firm line on plain scraper-board.



83b. Free line on plain scraper-board.



83c. Shading on plain scraper-board.



84. Experiment on embossed scraper-board.



85. Experiment on lined scraper-board.

This board is much used for the easy production of a pseudo-wood-engraving effect for commercial drawings, in which case it is painted black all over first, but it is also capable of suggesting special techniques of its own, as the examples on plain smooth board No. 14 show (83): (a) with firm line, (b) with free line, (c) with shading.

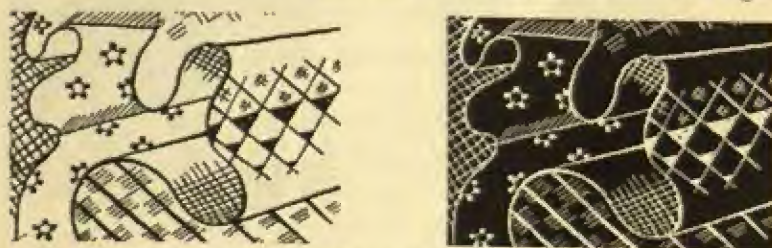
EMBOSSSED SCRAPER-BOARD

In addition to the plain surface, there are a variety of embossed scraper-boards with various patternings which do not show to the camera if left white or painted solid black, but can be brought to life by subsequent scraping with a knife. These embossed scraper-boards may be used for drawing with a brush, in which case the texture of the embossing may in lightly touched parts give its texture to the drawing.

Some of these boards are sold ready printed with black lines or dots all over them, as well as embossings. The texture already on the board may be added to or scraped away, to produce various effects (85) the possibilities of which can only be discovered by individual experiment on samples of the different kinds of scraper-boards.

NEGATIVE REVERSAL OF DRAWINGS

Alternatively, a black drawing on white paper can be 'transposed' by the block maker and rendered as a white design on a black ground (86). In this case the designer must not forget



86. Black pen drawing and a negative line block made from it.

to show the contour and limits of the intended black ground with a boundary line, or the block maker will not know how much of the surrounding white paper of the original to reproduce in black on the block. The same can be done with a crayon drawing (87).



87. Negative line block made from black crayon drawing on rough white paper.

Textures can be transferred to the drawing from inked pieces of canvas, lace, skeleton leaves, etc., but a good dense printers' ink must be used, and a definite texture free from grey parts must be given. The result would be similar to that achieved by similar means in Lithography (64j).

DRAWING FOR LINE BLOCKS WITH CRAYON

Line blocks of a granular nature can be made where softened effects are required, and in that case the design must be drawn with dense black crayon or with brush and body black paint, not with indian ink.

For a crayon drawing use a Venus Pencil No. 53, or Hardtmuth Negro, both of which give jet black dots of great density. The best paper to use is Cornelissen's lithographic Transfer Paper No. IIIB, or for finer grain IIIA and IIA also can be used successfully. These papers are coated with a plaster of paris and size compound, which grips the crayon better than plain paper and is very white. Examples of their textures are here shown (88).

Fine pen or brush work may be added for sharpening up detail. Higgins's Waterproof Black is used for this, but large solids, or even wide lines, cannot be put on these papers with a wet ink, as the coating will craze, or split up as the ink dries out, thus forming white veins where solid black was intended. For



IIIa

GRAPHIC REPRODUCTION

larger areas of solid black to be added to a crayon drawing on these coated papers, use body black paint in a dryish state. This will not materially wet the coating, and so crazing does not occur. Pen work has been added in the top example (88).

It is not advisable to work for great reduction in size, as the individual dots would diminish and the finest would be lost. A reduction to two-thirds length is, however, possible for drawings on IIIb.

Such drawings will rub very easily, though not so easily as if Conté crayon were used. They must be carefully protected, as a smeared area will confuse the photographic plate and so produce an indefinite block.



IIIb

DRAWING FOR LINE BLOCKS WITH STARVED BRUSH

It is also possible to draw for granular line blocks with a starved brush and body colour or poster black, rather stiff in the brush. The individual dots of the broken drawing must be definite and black. Indian ink will not produce this result.



IIa

PHOTOGRAPHIC REPRODUCTION

Such drawing may be done on the above Cornelissen papers, but the black paint must not be too moist, or in drying it will cause the surface to craze. Alternatively, any paper with a suitable crisp texture and good white colour may be used. Examples on three different papers are shown (89), at the top on rough Whatman, in the middle on cartridge paper, and below on bond writing paper with a small brush. It is possible to make this kind of drawing larger for reduction if fine quality is wanted, as a very intense black in the drawing is possible.

Line blocks made from crayon, starved brush, or spattered originals require extra care by the block maker, and not all block makers are experienced in this work. They may all be reversed to negative, as in example (87).

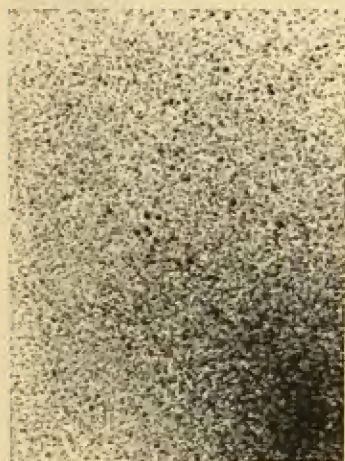
DRAWING FOR LINE BLOCKS WITH SPATTER ADDITION

The spatter method, described under Lithography, may also be used. Those parts to remain white are covered up with stencils cut from thin paper and fixed



89. Starved brush drawing.

temporarily on the drawing. Black body paint is then spattered from a soft stencil brush by stroking it with a knife blade or the edge of a piece of card, so that particles of black fly off (90).



90. Spatter.

Some prefer to use a sheet of metal gauze set in a wooden frame in the manner of a sieve, and to brush the colour on this so that particles fly off through it on to the paper. This is, however, more difficult to control.

There is a special kind of stencil paper prepared for this purpose, more particularly intended for use with the air brush. It is thin and semi-transparent, and has a kind of rubber

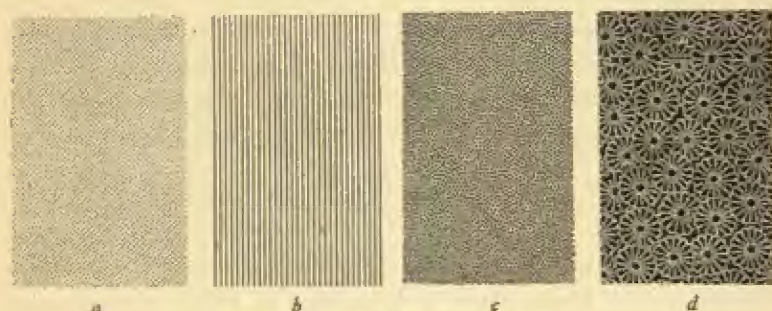
solution, ever-ready, adhesive on one side of it, so that it will adhere temporarily to the drawing. It may be readily peeled off again and thrown away. Its transparency makes easy the tracing of exact shapes preparatory to cutting out. It is called 'masking paper', and is sold by Cornelissen.

DRAWING FOR LINE BLOCKS WITH THE AIR BRUSH

Air brush is not suitable for line block reproduction. The ink is necessarily very thin in order to blow through the nozzle, and it does not give defined separate dots of uniform blackness, even when worked at its coarsest and well away from the paper. If the air brush is used, body colour black should be fed into it and not indian ink. In any case, the test of suitability of a drawing is to use a magnifying glass to see that all dots are of perfect density and that all remaining paper is quite white.

BEN DAY MEDIUMS

Another method of producing a regular stipple or texture on parts of a drawing is to use a Day Medium (91). This is a celluloid sheet in a light wood frame, one surface of the film having a relief texture, the other side being smooth. The rough side is evenly and thinly inked with printers' ink from a roller, and the film is then propped up over the drawing with, perhaps,



91. Four examples of Ben Day Medium.

a penny under each corner. It is then pressed into contact with the drawing in just those parts where the texture is required.

A special holder is sold for manipulating these mediums. It consists of a couple of pivots into which two corners of the wooden frame are set in such a way that the frame may be removed for re-inking or turned up to inspect what has been done. It may then be turned down on to the drawing again without losing the exact position.¹

A mask or stencil may be used to protect the rest of the paper if required, or process white may be used to correct blemishes or overrunning. When using this 'medium' on scraper-board, the surplus stipple may be simply knifed away. Considerable practice is required to produce an even result. The process was originally devised for lithographic draughtsmen,

¹ This holder and the Ben Day Mediums may be had from Messrs. Hunter, Penrose, Farringdon Road.

who ink the film with greasy transfer ink and rub the texture direct on to the stone.

The only advantage to the artist of applying the mediums direct to the design is that of personal control. He must, in that case, buy the celluloid mediums himself, but he will not probably wish to accumulate the wide variety of patterns available to most block makers. The Day Mediums are therefore more usually applied direct to the block.

Mechanical stipples, however, are not always the most desirable. Cross-hatchings and stipplings with the pen are less monotonous, capable of greater variety, and frequently blend better with the artist's drawing. Compare illustrations (80) and (91).

BEN DAY MEDIUMS APPLIED DIRECT TO BLOCKS

The block maker can apply the Day Medium, already described, to the block when he is etching it. Most block makers have a printed sheet showing the different mediums or mechanical tints they use, with register numbers for convenient reference.

They can all be introduced either as black textures on white areas (91 *a, b, c*) or vice versa (91 *d*), according to instructions. They are transferred from the celluloid either to the zinc plate or negative, according to whether they are to be in black or white. Mediums should be chosen with a view to the surface of the paper on which they are to print: some are too fine in texture for printing on rough papers.

If it is wished that a certain tint or medium be laid on part of a design that is entirely enclosed by a line of the drawing, it is enough simply to shade this part lightly with a blue crayon and write instructions in the margin, or, if the paper is suitable, a pale blue water-colour wash may be used. When a complicated arrangement of mediums is required, a tracing paper overlay may be used for marking instructions. Shadings with the blue crayon at different angles may be used to indicate the use of several different tints on one drawing.

If the tint selected has a definite direction, it may be necessary to instruct the block maker at what angle it should be laid.

When a tint is to be laid on part of a design not wholly enclosed by a line of the drawing, the limits may be simply shown on the tracing overlay, and the block maker's draughtsman will copy it in laying his tint (92).



92. A simple contour.

It may be, however, that accurate drawing of a detailed contour has to be formed by the tint without a supporting outline in the drawing. This requires particular treatment, especially if the block is being made smaller than the drawing, when tracing by the block maker would be impossible. In this case a supplementary, very fine pen key-line, or a fine dotted line, must be added to the drawing in black ink. This will be reproduced in the block and will give the block maker an exact guide. It will be tooled away after the block is completed, but instructions for its removal should be written on the margin of the drawing. In (93) such a key is shown partially tooled away. On the other hand, such key lines may be intentionally left in with good effect (94).



93. Key line partially removed.

Two tints may be laid over one another to give special textures. The effects of some of these combinations are usually shown in the block makers' specimen books. (94) shows a straight line tint similar to (91 *b*), but finer, laid twice at right angles.

A block can be made in two tints without any supporting

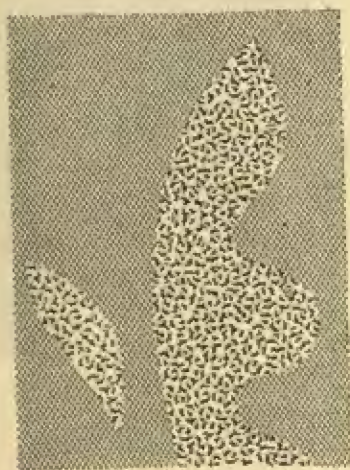
drawing in solid line. In this case a solid black drawing for one of the tints is made and the limits of the second tint are



94. Key lines left in.

shown on the drawing in fine key lines. From this the block maker prepares both a negative and a positive on two photographic plates. On to each of these he lays the appropriate tint, and they are printed one after the other on to the metal and etched. (95) shows an experiment in this method.

If a tint is to be superimposed in white on a black area of the design, this area must be drawn in solid black and the instructions written in the margin. If the white tint is not to cover the whole of the black area, a tracing overlay will have to be given to make clear the intention to the block maker.



95. Two unsupported tints.



96. Laying negative tint.

If such a drawing is prepared on scraper-board, a fine white key line can be scratched with a needle to act as a guide in laying a tint for an exact contour not otherwise contained in the drawing. Instructions must be given in that case to the block maker to stop this out on his negative when the tint is laid. Such a key line is shown with the negative tint only partially laid (96).

It should be noted that the tints are applied to the negative and to the block. They do not, therefore, reduce in scale if the drawing has to be reduced, but remain the same scale as shown in the block maker's specimen, whereas if tints are applied to the drawing they will reduce in scale with it.

BOURGES TINTS

The block maker can break a black drawing up with a series of white dots or lines over the whole of its area by the use of the Bourges tints. These are sheets of transparent celluloid printed



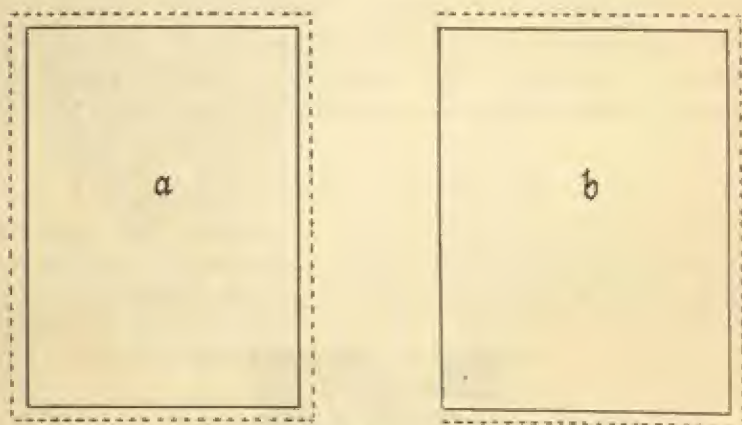
97. Solid drawing with Bourges tint.

all over with white lines close together, either in one direction only, or crossed in two directions, or simply with white dots, like that used in the example (97). Here the white dots have obliterated the black of the drawing. Bourges tints are very convenient when a newspaper has restrictions against the use of large solid areas of black. The result is practically the same as is obtained by using a negative Day Medium, but the cost of tint laying is saved.

PROCESSES OF GRAPHIC REPRODUCTION
TRIMMING ALLOWANCE ON
WORKING DRAWINGS

On designs which are to print right off the paper $\frac{1}{8}$ " extra drawing all round is required by the printer for trimming into the design after printing (98 *a*).

In the case of a cover of a booklet (98 *b*) the left side of the design would be drawn exactly to where the fold is to fall, but



98. Trimming allowance (*a*) for showcards, (*b*) for booklet covers.

the top, right-hand side and foot would need to have $\frac{1}{8}$ " additional drawing beyond the size of the finished cover.

This allowance would be included in the block, and after printing and completing the booklets the surplus would be trimmed off by the printer.

The $\frac{1}{8}$ " allowance is to be on the finished work. If the drawing is made twice the length for reduction, a $\frac{1}{4}$ " must be reckoned, for this also will be reduced.

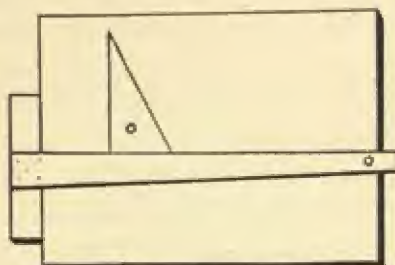
If such allowance has not been included in the drawing it might well be a very delicate matter to add the necessary $\frac{1}{8}$ " to the artist's drawing without showing a break.

There is a tendency for the covers of thin booklets to crack

slightly at the back fold, and this suggests that uninterrupted dark colour should not be carried over the fold, or the colour of the cover paper itself may show through the ink.

PRESENTATION

A word should finally be said as to presentation. A drawing that is submitted with torn edges, soiled, or crooked on the paper, is at a disadvantage. It is a great help if drawings are submitted with a tidy general appearance, and, if a rectangular



99. Square drawings should be square.

drawing is intended, it should be in fact a rectangle. A T-square and set-square are vital requisites (99), and some stout paper folders in which to fix designs are a good investment (100). Drawings have to pass through many hands before they are done with.



100. Drawings look better mounted.

THE MAKING OF THE LINE BLOCK

These preliminaries of drawing technique have been gone into fully here because much of what has been said applies equally to drawing for colour line work and to drawing for every other process which has photography as a basis.

Having made, from the clear and definite drawing, an equally clear negative to the size required, the block maker will print this photographically on to a plate of polished zinc, which he has previously coated with photo-sensitive albumen.

The light, passing unrestricted through the transparent parts of the negative, which correspond to the black ink of the drawing, will harden this emulsion. The emulsion, which is protected completely by the dense black of the negative, will remain in its original soluble state.

The zinc is then rolled all over with ink of a greasy nature. It is soaked in water and the albumen which has not been hardened by the action of the light dissolves away, carrying the ink with it. The plate is dried and then dusted over with finely powdered resin, which adheres to the ink left on the image. The resin is melted on to the plate to form an acid-resist. The back of the plate is coated with acid-resisting shellac, and the plate is etched in an acid bath.

Subsequently it is dusted with resin again and etched yet deeper; this is repeated until the background is bitten away by the acid to a sufficient depth to prevent it touching the ink roller or the paper in the printing machine.

This is a brief and not very technical description, but it is purposely so. The point to be appreciated is the general procedure, so that the importance of a clear and definite drawing may be understood.

If some lines of the drawings are not full strength, or if the paper is not white, the acid-resist will be indefinite, and the result will be a ragged plate. The block maker, in trying to

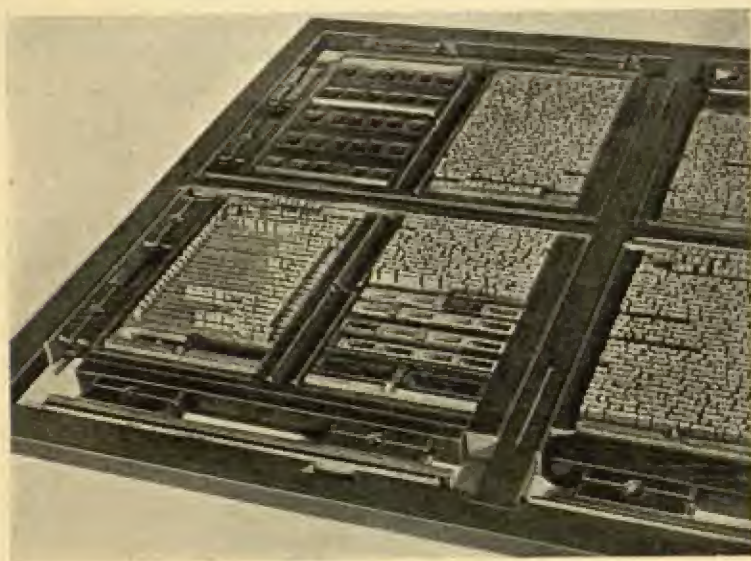
strengthen weak parts of the original, may clog the more vigorous parts.

It will be seen that in the photography, inking, baking and etching processes, the slightest misjudgement will result in a faulty printing block. It is remarkable, therefore, how exactly even a fine drawing may be reproduced by this method.

LETTERPRESS MACHINE PRINTING

At this point it may be well to describe the way in which an extensive supply of copies is made by the printer from the line block thus produced.

The process employed is known as Letterpress printing, from



101. Book pages in a 'forme'.

the fact that it is the process by which the type of reading matter is printed. The underlying principle is purely mechanical in this case. Everything that is to print is of a certain height—0.916" to be exact, or approximately the diameter of a shilling

piece, as may be seen by reference to (78). All the remainder is kept below that height by approximately $\frac{1}{8}$ ", more or less, according to the size of the blank area. This is because paper and ink rollers will naturally dip deeper into large areas than into small ones.

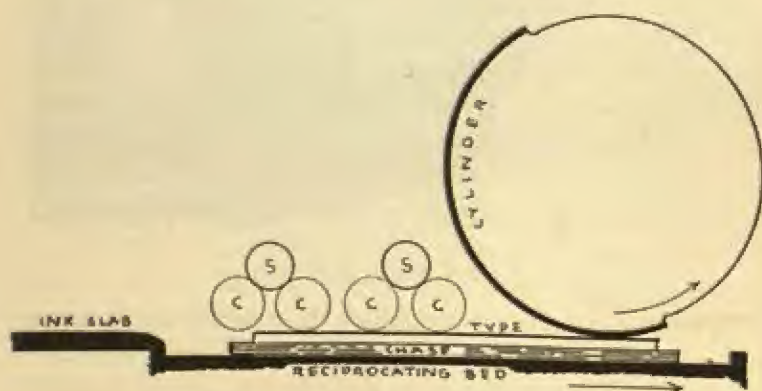
Type, brass rules for straight lines, wood-engravings, line blocks, etc., are securely clamped together in their correct relative positions in a 'chase' or steel frame.

In this they are held as an integral unit as a 'forme' to be put in a machine and printed. All white spaces—for example, blank pages and the margins in books—must be filled out with material of lower height (101).

This forme is then lifted into a letterpress printing machine, of which there are many kinds, all operating on the same principle. It is not necessary here to describe the three main classes of machine, because they do not greatly affect the designer.

THE MACHINE

We will suppose that a flat-bed cylinder machine of the type most used is in commission. The parts which perform the printing are here shown in diagram form (102).



102. Printing parts of a letterpress machine.

The machine has a flat steel bed on which the forme is laid. This explains the technical jargon that such-and-such a job has been 'put to bed', meaning it is actually in the machine, and cannot be altered. This bed is on runners, on which it travels backwards and forwards each time a copy is taken.

Over this bed is suspended a heavy, but exactly planed, steel cylinder which revolves in very solid bearings. It is this cylinder which will roll the sheets of printing paper against the face of the forme as each copy is printed.

INKING MECHANISM

Above the bed are also suspended a number of ink rollers for applying ink to forme. These (*c*) are coated with an elastic composition consisting of glue, treacle, and glycerine. There are other steel rollers (*s*) so fixed as to be in surface contact with the composition rollers. A trough of ink, or 'duct', affords a means of issuing the ink in regulated quantities to the ink slab, which is an integral part of the bed, and which supplies the forme rollers.

The bed with its forme travels to and fro under the ink rollers and the cylinder. The ink rollers, which must have exactly the right amount of ink upon them, pass their ink on to the whole face of the forme—type, blocks, wood-engravings, etc.

It is necessary to keep the ink adjustment regulated to suit the requirements of the work. The ink issued from the duct, which extends across the width of the machine, can only be regulated across the width. Any parts of a forme being close together, or in line lengthwise in the machine, must receive the same amount of ink from the rollers. It is therefore difficult to obtain very full solids in close juxtaposition to fine and delicate lines or type. A heavy design with fine work in it, typified by the work of Aubrey Beardsley, is most difficult, and a consistently heavy drawing or wood-engraving in conjunction with small sizes of more delicate type pages makes a similar

difficulty. One or the other must suffer. The fine drawing or type must be over-inked, or the large solids must be under-inked. More particularly is this so when a paper is used which is not very smooth, as such a paper requires heavy pressure and comparatively more ink in printing.

On the other hand, a very thin film of ink can be carried on the rollers when all parts of the forme are of equal delicacy. This explains the admirable machining of line blocks from light pen drawings in some of the cheaper journals which could not otherwise be described as 'well printed'.

The bed of the machine travels to and fro under the inking rollers, which apply ink to the face of blocks and type. Each sheet of paper is laid to the cylinder and is then picked up by a row of 'grippers' set into its face. As the cylinder revolves, the sheet of paper is carried round with it. The paper is thus pressed firmly to the inked face of the forme and the impression or copy is made.

'MAKE-READY'

But this is not all. In the first place, the elements which go to make up the forme are not exactly the same height, and one-thousandth of an inch is the limit of discrepancy in pressure that will give good copies.

Furthermore, heavy solids require more pressure than delicate lines, and some hours of work must usually be done on the surface of the cylinder before printing can proceed.

The cylinder is covered with three or four sheets of paper to which are attached 'make-ready', that is, thin sheets of paper are built up or cut away to produce the necessary relative thickness, and to give the required pressure on every part of the forme.

There is also special make-ready to be done in the event of half-tone blocks being included in the forme. This is called Underlay, Interlay and Overlay.

'Underlay' comprises paper or thin card pasted to the

bottom of parts of the mount to bring the whole block and mount up to uniform thickness so that the face is all at one level.

'Interlay' refers to varying layers of paper placed between the mount and the metal plate to raise, broadly, those portions of the plate which represent the darker tones. Those parts will then meet the printing paper with greater pressure.

'Overlay' is the application of a carefully prepared individual make-ready to the cylinder. This is formed by cutting out from impressions of the half-tone block made on thin paper all the darker parts of the subject, and pasting these on to a basic print, then cutting away altogether from this built-up overlay the lightest parts of all. Often as many as five thicknesses of thin paper are used on the darkest parts of a subject.

This increasing of pressure on dark portions of a half-tone plate and easing of pressure on the light parts produces the full brilliancy in a good half-tone print. Without it even the best block will print with great lack of contrast, and incidentally will be completely ruined for future use.

When all is complete, and the copies coming from the machine are good, any number of good copies can be 'run off'.

DRAWING FOR LINE BLOCKS IN TWO OR MORE COLOURS

The preparation of designs or working drawings for a series of coloured line blocks differs in certain respects from that for monochrome work. Certain methods are best, but are sometimes not acceptable to the client, or it may be that, working at third hand through an agent, one is forced to prepare a finished design in full colours. This is, however, not the best course.

The photographic principles of block making will be exactly the same as described for monochrome blocks. That is to say, for each block in whatever colour it is to be printed a black-and-white drawing must be prepared from which to make a negative of the required size.

If a fully coloured original is sent to a block maker, he usually traces each colour in black, and from these tracings makes his negatives. He may, however, be able to use special plates and colour filters in his camera, if it is a case of an intricate line drawing supplemented with tints of clear colour.

These special materials are expensive in themselves and require skilled handling, so that for reasons of economy the tracing method is usually employed. To avoid this tracing, drawings must be prepared in a special way.

SEPARATION OF COLOURED ORIGINALS

The nature and use of colour filters may be described as follows. If, with an ordinary photographic film, an exposure is made of a person in a blue dress with a red rose, the dress will show in the final print as white, and the rose as black. This effect can be reversed by the use of colour filters.

With special plates, sensitive to the entire spectrum, and coloured glass of the complementary colour, it is possible to make any one colour of the spectrum photograph black. It is also possible to prevent any one colour from photographing at all. It is not possible, however, to eliminate the whole range of colours, nor can all of them be photographed as black at one and the same time. By intensifying the photographic activity of one colour to light, the activity of the colour diametrically opposed in the spectrum is reduced.

It is clear, therefore, that filtering will not remove a whole range of colours from a coloured black drawing.

A black drawing with blue as a second colour (103a) is a very easy matter. An ordinary plate is used and the black will photograph unhampered by the blue; a tracing will be made in black ink for photographing for the colour block (103b). This is a very much used method. A black drawing may be prepared, and a second colour, no matter what it is to be in the final print, may be indicated in blue, just as when indicating a mechanical tint or medium (see page 79).



(a) A two-colour drawing; the second colour shown in blue.



(b) A black tracing for the colour printing block.



(c) Black drawing for orange printing, on blue key.



(d) The two blocks printed in the intended colours.

PEN DRAWINGS WITH COLOUR WASH

In order to avoid either tracing or filtering of the colours when more than one colour is to be used, it is best to make the black drawing and leave it uncoloured.

Fasten over it a flap of tracing paper, and indicate on that the colour scheme intended. If this is done tidily, it will be quite possible for the client to consider the effect of the finished work.

The line block for the black can then be made in the most straightforward way, and at a saving of cost to the client.

If the colour is merely to fill areas entirely enclosed by black lines of the drawing, or is to be of very elementary form, there is little point in the artist making the working drawings. If, however, sensitive drawing is intended in the colours themselves, he will probably wish to make black drawings for them himself in the following manner.

The working drawings must be made in BLACK, each upon a separate pale blue impression of the first block. The blue printing will not photograph at all, and will afford an accurate key. Such a black drawing on a pale blue impression is shown (103c).

If there should be trouble from the black ink or paint not taking on top of the blue printing ink, this may be overcome by rubbing the print with a little pumice powder, obtainable from any chemist, on a piece of clean rag. This is the method of the old scribes who 'pounced' their vellum before attempting to write upon it.

Colours may fall one over another, but the effect is not usually as bright as might be expected. Colours of similar nature help one another; contrasting colours dirty one another, just as in painting. Colours printed on top of one another, moreover, cause a gloss on the ink. Mark the colour to be used on the corner of each working drawing.

It is also useful to get from the printer a few black impressions of the key block on a paper suitable for painting, and these

may be used for trying out the exact colour scheme, as well as for making a hand-coloured guide for the printer.

The blue impressions may, of course, be printed on to any paper or card, drawing paper, scraper-board, or paper for crayon work, which should be sent to the printer by the artist so that he is sure of having just the working surface that he likes.

When the black working drawings are complete, the block maker will photograph them and make them into a set of line blocks to exactly the same size as the drawings. They will then fit exactly the first 'key' block already made when printed in their final colours. The example drawn at (103*c*) is shown printed in its final colours at (103*d*).

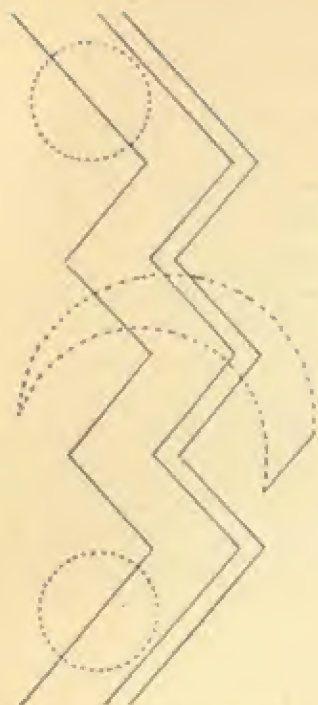
COLOURED DESIGNS WITHOUT LINE KEY

If a design has no natural key in its printings, it must inevitably be made in the outset as a fully coloured original. In designs where precision is imperative, it is best in reproducing to draw a key with indian ink (104*a*), as a first step to making the working drawings. If the nature of the design demands a specially fine key, this drawing may be made larger than the required size and reduced by the block maker so as to get the advantage of a fine line.

All detail must be included in this—where colours meet or overlap one another, and where their relative position is important to the design. Detail need not be included if it is not essential as a guide in the working drawings.

A line block is then made from this temporary key drawing to the size of the finished print. Some blue impressions must be printed lightly on to paper of whatever quality is required for working drawings (104*a*). On a set of these blue prints black drawings are made for each colour. A separate blue print is used for each.

The key block is of considerable help to the printer, who can make a few impressions of it in position on his paper as a



(a) Blue print of key for design, to the right.



(b) Fragment of design where relative position of colours must be exact.



(c) Fragment of design capable of direct tracing.

preliminary to running off the supply of copies. Into these he will fit each colour as he commences to print it. He is thus free to print the colours in whichever order best suits the design, without having to consider which sequence will best enable him to fit the colours one to another.

This method often makes it possible to print black last, whereas without the key it is often necessary to print black before the other colours for positioning purposes. When this is done, the colours, however transparent the ink, are apt to spoil the black. The slight cost of this extra block sometimes prevents its use, though it is frequently most desirable.

If very fine and exact detail is required, the key block may itself be larger than the final job, in which case all the working drawings will be reduced in block making; a black impression of the key itself being reduced with them, for the use of the printer.

If no key block can be made, it is still best to draw a key in black ink and to trace the black working drawings from this. If accuracy of fit demands it, this key drawing may be made several times larger than the final size, and the working drawings traced from it will be reduced together in the block making.

The alternative of tracing black working drawings direct from the design will suggest itself, but it is usually difficult to gauge accurately the amount of overlap that is given to each colour, and it is, in general, not easy to see what is being done when tracing from a coloured design. This direct tracing method can, however, well be used for such free styles of design as shown at (104c), where exact fit of one colour to another is not a characteristic.

OVERLAP OF COLOURS

On a large quantity job it is practically impossible for the edges of two-colour surfaces to be printed to coincide exactly, therefore a slight overlap of one colour on another must be allowed.

On small work, rather less than $\frac{1}{32}$ " in the finished scale of the block is sufficient. When work is to be printed on a large sheet and on the cheaper grades of paper, $\frac{1}{16}$ " may well be allowed.

In the completed print it will be the darker of the two colours that will form the visible line. The darker colour should therefore be drawn exactly to the key, and the lighter colour should be drawn beyond it. A middle tone will, therefore, in some positions be drawn exactly to the key, and sometimes beyond it, as it falls against a lighter or darker tone in other colours.

In colouring up to a bold black outline where the colour is to meet the black this slight overlap should also be allowed, but if the black line is a very fine one the drawing must very accurately follow the line, keeping, if anything, inside it. A projection of colour beyond the black line is more noticeable than a slight shortcoming.

A TRACING FRAME

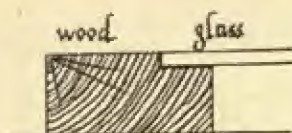
For this work of tracing a simple accessory that will be of great assistance can be made for a few shillings. It is in effect a transparent drawing board, made by setting a sheet of glass in a strong wooden frame. This can be set up on legs, or it can be propped up firmly on two piles of books (105).



105. The tracing frame.

The frame may be made from $1\frac{1}{4}$ " square soft wood. Into the inner top edge of this a rebate is cut $\frac{1}{4}$ " wide and rather less

than $\frac{1}{8}$ " deep. A sheet of ordinary picture glass is set into this rebate with putty so that the top surface of frame and glass is level (106). A 1" edge of soft wood is thus provided, into which

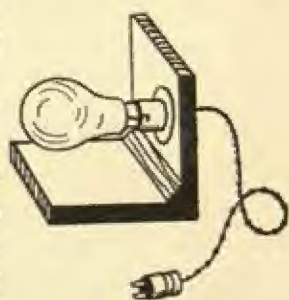


106. Structure of the frame.

drawing pins can be thrust, and against which, if necessary, a T-square can be used.

A small table standard lamp can be laid on its side under the glass, or a special stand, made from two pieces of wood and a flush lamp socket kept for the purpose (107). The frame must be sufficiently far from the lamp to prevent the glass from becoming uncomfortably heated.

If electric light is not available the tracing frame can be set up at a slope with a mirror underneath it on the table, and a lamp set so as to throw the best possible light on to the mirror. The lamp must be screened from throwing light on to the face of the work. The frame should in this case have a much wider wooden edge. A suggestion is shown using a window (108).

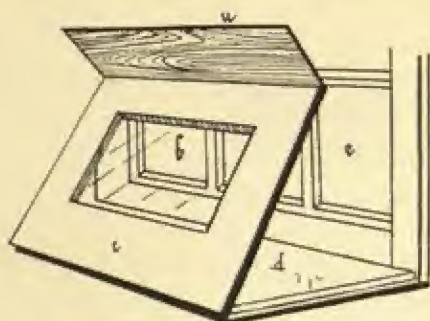


107. A special lamp.

It will be found that the light coming up through the work will render tracing far more accurate than when only top light is used; also it will be found possible to work on stronger paper than tracing paper. Whichever form of illumination is used, top light must be partially screened from the face of the work.

The original is pinned on to the wooden edge of the tracing frame with a sheet of drawing paper over it, and the key is

traced through, or the key is pinned down and working drawings made on successive sheets pinned over it.



a. plywood shade b. glass e. window (or lamp)
c. wood frame d. mirror

108. Daylight tracing frame.

It is even possible, and sometimes convenient, to trace through two or three sheets at the same time. For example, in a bold two-colour design the original coloured drawing with two pieces of thin paper over it may all be pinned down together as a pad. The first colour is drawn in black on the lower sheet. When dry, the second sheet is turned down over it, and a second colour is drawn with both design and first black drawing as a guide. This would apply to such a style as shown at (104c).

SOME DIFFICULTIES

The wide variety of different kinds of design makes it difficult to provide the best advice for every contingency. Some designs, whilst not having one colour which forms in itself a key, rely upon very accurate fitting of colours for the smartness of their effect. These are the most difficult to form rules for, but the artist's uppermost thought must be the preparation, when possible, of a working drawing for a finished print, rather than

that of making a pretty original. The effect of the finished colour print can be shown in a rough accompanying the working drawing.

In such a case, supposing, for example, that there is a lot of fine lettering to be printed finally in colour, and also small details of drawing to be printed finally in black, and furthermore that these do not actually butt on to one another or fall over one another in any place; in such a case both the lettering and the black in the drawing may be carried out on one piece of paper in black, and the subsequent colours drawn on separate papers. The block maker will then make two blocks from the first drawing, and cut away from each the work not required. This is, moreover, the most accurate way to ensure absolute relative fit of two colours, and can often be used.

Advantage may be taken of the fact that vermilion will photograph just as strongly as black, and therefore drawings for two different colour printings, whatever they are finally to be, may be made on the same paper if they do not touch or fall over one another. Thus a design may be drawn in black, and lettering or decoration intended to print in, say, blue, may be drawn in vermilion. The block maker will make two blocks and rout away from each the work not required. If the lettering or decoration were drawn in blue it would have to be traced by the block maker, with inevitable loss of character or sharpness.

It is well if, as is presumably the case, one wants a smart and accurate job to result, to prepare a design with consciousness of the order in which colours will be printed, so that the colours build on to one another in natural sequence. In book illustration, the black, if there is one, has usually to be printed first with the type pages. More particularly is this so if the illustrations are set into the type and do not form separate pages on their own.

In the preparation of working drawings for colour line blocks, full advantage can be taken of all methods of obtaining texture which have been described in dealing with uncoloured black

drawings; pen hatchings, and stippling, crayon, Day Mediums, spatter brush, or scraper-board. The well-known Caldecott wood-engravings show what could now be approximated with Day Mediums.

CHARACTERISTICS OF INKS

A considerable variation of effect can be obtained by the printer from one and the same block, and it is well to give instructions with the drawing as to any special effects to be aimed at. On most papers, printers' ink can be made to dry either shiny or matt, and some inks are transparent, others opaque. There are special matt oil inks, and these may be used in conjunction with transparent colours.

There are also metallic inks, silver and gold, but these latter are only satisfactory when printed on 'art' paper, i.e. clay-coated paper. On other papers an underprinting from the same block of a suitable coloured ink is required to smooth out and size the paper, so that the medium of the metallic ink shall dry on the surface and not sink in. This indicates that in printing metallic inks on non-coated papers only broad effects are suitable, and that fine lines are not.

Gold and silver is also obtained by printing the design first with a particularly sticky ink of suitable colour and then dusting over it metallic powder. This adheres on the design, and when dry the surplus is wiped off. The operation is unhealthy and is not therefore to be much encouraged.

Powdered coloured glass can be applied to designs in the above manner, as can also flock powder, which is a kind of fine felt dust obtainable in colours. These are, however, somewhat fragile in the resultant print and must be used with caution.

A word more should be said on the matter of opacity of ink. Delicate work cannot be printed with a heavy coating of coarse ink. A thin film of printers' ink is at best a very thin film indeed, and, as such, even the densest ink will be more or less transparent. On white paper very bright colours are obtainable, but

light colours cannot be rendered on dark paper without printing several times. This indicates again that only broad effects can be so produced.

Similarly, on a coloured paper a contrasting colour cannot be rendered without the printing ink being much affected. Red will print on yellow paper and be brightened by it, but blue printed on yellow paper will be turned to green.

Different coloured inks printed over one another do not result in brightness, but useful tones can be so obtained either with solids or cross-hatchings, as will soon be found by experience.

(B) CONTINUOUS TONE METHODS

So far, all the methods described have been capable of grouping together under the general label of 'line' reproduction. The original design has in every case been definite in its technique, with no gradation of tone. Even with the grained stone of the lithographer the particles of chalk are definite spots of pigment on white paper. It is for just this reason that when crayon is used on stone to get a continuous tone effect, the result is pleasant and vital.



109. Portion of a continuous tone subject.

Next to be dealt with are the methods employed for reproducing designs in graduated tone exemplified by wash drawings, water-colour paintings and photographs (109). This whole group of processes is again capable of being employed either in black only or in a series of colours one after the other, to make up a coloured design.

HALF-TONE BLOCKS

The basis of the most used and cheapest of these methods is 'half-tone'. It is, in fact, a method of splitting the continuous tone of the original into a mass of tiny individual dots of varying size, which, when printed, give the optical impression of a graduated tone of smooth texture. A fragment of such a block

is here enlarged and printed (110) to show the dot formation.

THE SCREEN

The underlying principle of the half-tone screen is, that light passing through a pinhole spreads out in a cone-shaped beam. A 'screen' is rather like a sheet of close wire gauze. It is made from two sheets of plate glass. Each sheet has parallel lines engraved on it, which are filled with opaque black. The black lines and the clear glass between them are of equal width. The two sheets are cemented together face to face with the lines at right angles to one another, and the result is an infinite number of 'square windows' of clear glass. A magnification of part of a screen is here shown (111).



110. Half-tone print enlarged.



111. The screen enlarged.

THE NEGATIVE

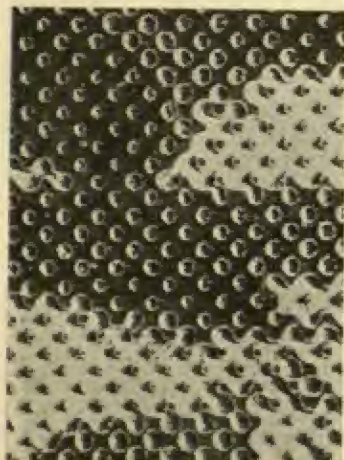
The original to be reproduced is set up on an easel in front of the camera and evenly illuminated. The half-tone screen is set in the camera slightly in front of the photographic plate, and when the exposure is made the image comes to the plate through the holes in the screen.

Where the tone value of the original is very light the strong beams will run into one another and only minute specks of the negative will be unaffected. At dark parts of the subject the beams will be very small and will leave the plate almost entirely

unchanged. The negative, when developed, will show the subject broken up into dots of varying size. This will be understood by reference again to the enlarged fragment at (110).

THE BLOCK

This negative is printed on to a sheet of photographically coated copper, which is then etched with acid in much the same series of operations already indicated in dealing with line block making.



112. Microphoto of half-tone block $\times 15$.

The result is a block which is broken up into raised dots of greater or smaller size according to the darkness or lightness of the different parts of the original. In the darker parts the dots run into one another, forming an almost solid area of metal, with pinholes eaten away. In the light parts tiny points of metal stand isolated on a much eaten away back-

ground. Reference to the microphotograph (112) shows how the block is made up.

ETCHING

In the etching process above briefly referred to much hand control has to be exercised in order to render the contrasts as emphatic as they are in the original. The unaided mechanics of the method would produce a series of gradations much flatter than in the original. Thus the work is again in the hands of the copyists at this 're-etching' stage.

Re-etching is a process similar to the etching of an aquatint plate. The plate is etched in stages, and the parts, as they attain

the correct lightness, are stopped out with a brush and acid-resist.

In the normal half-tone block, very fine dots remain, even where white paper of the original is represented, as seen at the top of illustration (110) and in the background of (113), and this gives a continuous bearing surface for the rollers and paper in printing. Finally, the block is trimmed square at the edges, and mounted type-high on wood or metal. It then looks like this (113).



113. Half-tone block mounted for printing.

There is a new process of removing the superfluous copper by electrolysis instead of with acid. This produces deeper and better blocks, but as far as the preparation of the design is concerned, the requirements are identical.

Half-tones, unless otherwise instructed, are trimmed to a rectangular shape, i.e. 'squared up' as (113).



114. Deep-etched half-tone block from pencil drawing.

DEEP ETCHING OF HALF-TONE BLOCKS

If the white paper of the original is to be rendered quite free from even the finest dots, as, for instance, in the half-tone reproduction of a pencil or brush drawing, the etching may be carried a stage further. In this case, when the pencil lines have been etched to their correct strength, they are each painted over with the resist and a final prolonged etch then removes all

the background to a considerable depth. An example of pencil drawing is shown so treated (114).

This method is also often used in the reproduction of brush drawings. The various tones of wash are all finally painted over with resist, and the background is then completely etched away. This work is, of course, charged by the block maker at a higher price than the standard half-tone prices, as are all special finishes.



115. 'Cut-out' half-tone block.

CUT-OUT HALF-TONE BLOCKS

Alternative, but somewhat similar in effect, is the 'cut-out' half-tone. The half-tone of an original of irregular but simple shape stands out on clear ground in this finish. The half-tone block is made in the ordinary way. The shape is then engraved round

with a burin, giving a white line to define the contour. The background is then routed away to a sufficient depth to prevent it printing (115).

COMBINED LINE AND HALF-TONE BLOCKS

It has already been stated that even a dense black in the original will be reproduced in a half-tone block with fine white pinholes over it, as is seen on the right-hand edge of illustration (110). It may, however, be desired to give to the black lines of a pen and wash drawing the full intensity of unbroken black, as in (116). This has also been done in (125) on the hat.

This is done by the block maker, when required, at extra charges, by various special means according to the nature of

the original. Fine black lines may be made solid by running a needle along them in the negative, and larger surfaces may be similarly scraped away on the negative with a knife.

Another method is to make a positive from the half-tone negative and paint the blacks in solid on this positive, after which another negative is made by direct printing from the retouched positive and the block is made from this.

Or again, the parts of the design may be capable of separation. In this case two negatives may be made, one half-tone and one line, to exactly the same size and each from the whole design. The various parts of each will be cut around with a knife, stripped from their glasses and re-assembled like a jigsaw puzzle on a fresh glass support to make a complete negative.



116. Combined line and half-tone block.

LINE ON HALF-TONE BLOCKS

Under the same head come combined line and half-tone blocks of a more controlled kind. A continuous tone or wash drawing and a separate black-and-white drawing may be prepared individually on two pieces of paper, but in relation to one another, so that when superimposed they will form a design. Or a photograph may be used instead of a wash drawing.

These will be separately photographed by the block maker as half-tone and line negatives respectively. If the line work is to fall in black over the half-tone, the negatives will be printed consecutively on to the copper, and then etched, producing a

printing quality similar to the previous example; that is, the black drawing will appear entirely black and superimposed on the half-tone. Printers' type may thus be superimposed on a wash drawing or photograph without the need to draw it into the design. An example of such a block is shown (117).

WHITE LINE ON HALF-TONE BLOCKS

If, on the other hand, clear white drawing or lettering is



117. Black line on half-tone block.



118. White line on half-tone block.

required within the area of the half-tone, a slightly different procedure is followed. In this case, what is to be white will still be drawn in black on white paper. A line negative from this will be reversed by the block maker to a positive. He thus has a transparency rendering black lettering or drawing opaque on his otherwise transparent film.

This film and the half-tone film are laid together against the copperplate, and one photographic printing produces the complete acid-resist. The lettering or line drawing is eaten away completely in etching, so that it is rendered white on the background of the half-tone, as seen in example (118).

HALF-TONE SCREEN GRADES

Half-tone blocks are made with screens of various degrees of fineness, from those used in newspapers (which usually have 45 to 80 lines to the inch each way on the screen) to the finest, which have 200 or even more lines to the inch. These latter are only printable on very highly glazed coated papers. The most used screens have 120 or 133 lines to the inch. Examples of these screens are obtainable from any block maker.

A well-etched block of 100- or 120-line screen can be printed on an uncoated paper, especially if the tones of the subject are all in a light key, as in pencil drawing, so that the printing surface is in the nature of separated dots. Dark and middle tones, where the dots run into one another, are not so good for printing on uncoated papers. The extra ink required in printing tends to fill up the small pits in the block seen in the top left corner of illustration (112), and such subjects therefore require coarser screens on this class of paper. Illustrations (109) and (113) are made with a 120-line screen, and printed on such a paper in this book.

It is best for the uninitiated to show the block maker the kind of paper on which the block is to be printed and leave the selection of screen to him.

SPECIAL HALF-TONE SCREENS

Special screens of various kinds are available. Their effect is only visible when used in coarse grades, and they should be employed with caution where detail is present in the original.

The 'vertical' screen is the most simple variant and is obtained with the ordinary ruled screen turned so that the lines of it run vertically and horizontally instead of diagonally. This gives a surprisingly different appearance to the block, especially when the coarser grades of screen are used (119).

The 'one-way' screen has lines ruled one way only, and reproduces the original in a series of lines that swell and contract

to form the shadows and lights of the original. This latter is effective if used vertically on an architectural photograph, or horizontally on such a subject as a photograph of an engineer's lathe, in which the lines of the machine run for the most part in a horizontal direction. In the darkest tones a cross line develops through a trick of the lens (120).

The effect just referred to can be accentuated by putting a specially shaped 'stop' in the camera lens and using the one-way screen. This increases the tendency to develop cross lines in the darker parts, and gives a block of strong contrasts which prints well in newspapers (121).

A 'curved one-way' screen has been used effectively for portrait blocks. It may be suitable where roundness is to be emphasized (122).

The 'linen' screen gives the texture its name suggests. It prints well, even on roughish paper, and for some subjects has a suitable informality (123).

The 'Erwin' screen (124) is formed in irregular particles instead of in ruled lines, and gives a texture not unlike a fine-grained litho stone, but its use results in a loss of contrast as compared with a ruled screen. This must be allowed for. This screen prints well on uncoated papers and on newspaper. Another screen of similar quality, but finer texture, is the 'Hatte'.

The 'mezzograph' screen is little used now, having given way to the last-named 'Erwin' and 'Hatte' screens because of their greater uniformity. It is produced by melting fine bitumen dust on to a glass plate, and the natural texture it gives may be peculiarly suitable for rendering certain subjects.

DESIGNING FOR HALF-TONE

Designs for half-tone reproduction may be made in various ways. It is first of all important to remember that as they will be rendered in continuous tone, everything that is visible in



119. Normal 65-line screen turned vertically.



120. The one-way screen.



121. A special screen.



122. The curved one-way screen.



123. The linen screen.



124. The Erwin screen.

the original will come out in the printing block. Pencil lines under a wash tint, crumple marks in the paper of the original, mended tears or the edges of patches, would all be reproduced by the half-tone screen. It is therefore important to make a clean and definite original.

Pen line, or brush line and wash originals (116) may be prepared with indian ink reduced to the required strength. The ink wash must be, if anything, of a brownish tint rather than bluish, and for this purpose, if necessary, a touch of sepia may be added. Higgins's Waterproof Ink gives the right kind of colour. Brown ink may be used, but it is not so definite in reproduction.



125. Drawing in black and white on grey paper.

Originals on toned or coloured paper are not easy for reproduction. To make a toned paper reproduce as if it had been white requires special plates and colour filters which reduce the contrast of the subject.

Toned paper may, however, be intentionally used and worked on with process white and ink wash (125). The tint of paper should in this case be in the same range of slightly warm greys as the reduced ink. If paper of another colour is used, its tone value to the photographic plate will not be the same as its appear-

ance to the eye. Body colour black should not be used by the inexperienced in the same original with indian ink, as the two photograph with different tone values.

Some very effective designs are made in body colour, using a definite range of tones without gradation. This is perhaps the best way of using the medium. Body colour, more than ink

wash, changes in tone as it dries, so that one should mix the tones required and dry samples as a guide before starting work. An experimental fragment in this technique is shown at (126). Chinese white and black paint with a little sepia is the best medium for this kind of drawing. It is best to work the design up, starting with the light tones and adding the darker ones.

The body colour must be made to lie flat on the paper and not worked so thick as to form ridges of pigment, for these will throw shadows in photographing. High-lights can be picked out with process white, which photographs clear white, but it must be laid on carefully and quickly when the other paint is quite dry, or the black will work up into it.

Originals for half-tone reproduction can be built up in solid three-dimensional form, but this borders on the province of the camera artist. The shadows thrown in making the photograph are part of such a design, so that the photograph itself must be made under the control of the designer.



126. Drawing in black, two greys, and white in body colour.

PHOTOGRAPHS AS ORIGINALS FOR HALF-TONE

The best kind of photographic print for making half-tone blocks is stated, in the Sun Engraving Company's excellent Compendium on Block making, to be the purple-toned P.O.P. print with a glossy surface, but a good black bromide print on glossy paper will give good results. Brown-toned bromide prints and prints on rough paper do not give good results.

It is particularly important that any retouching that may have to be done on the print should be carried out with pigment of the exact colour of the print itself. Bluish retouching will come out in the block much lighter than it appears on the original. Chinese white and lampblack make a good retouching medium on black prints. High-lights, if they are to be picked out, should be touched up with process white.

Pinholes, paper-clip marks and creases in photographs are difficult to eradicate, as are also indentations from heavy writing on the back.

Originals may be made up in *appliqué* from photographs and drawings. This in modern jargon is called 'Montage'. The various parts should be of similar colour and thickness, and care must be taken to avoid edges which throw shadows. The various parts must not be stuck over one another, but cut out like a jigsaw puzzle and mounted together on a card so that the surface is flat.

Fanciful figurines cut in paper or metal, or modelled, may be combined in photographs of solid objects. Double exposures and unusual angles produce special effects to express ideas.

Photographic prints are produced without the camera by casting shadows and reflections on to bromide paper. In a similar way light is allowed to fall on a bromide paper through an arrangement of translucent objects to form an X-ray-like print. The two latter methods produce a kind of print which has been christened on the Continent 'Photogram' by their chief exponents, Maholy-Nagy and Man Ray.

HALF-TONES IN COLOURS

The principal process under this head is the 'three-colour' or trichromatic process, so called because the basis of the method is the splitting up of the original photographically into the three primary colours, yellow, red, and blue, and the making



1st, the Yellow plate is printed.



This is a Black impression of the Yellow plate showing the strength of colour.



2nd, the Red plate is printed on the Yellow with the above result.



3rd, the Blue plate is printed on to the Yellow and Red with the above result.



Last, the Black is printed, giving the finished picture.





of a half-tone block for printing each of these. This process of 'colour filtering' is also used in connection with various other colour printing processes which are based on photographic reproduction, and will be referred to again.

SPLITTING INTO PRIMARY COLOURS

The method of splitting up the image may best be explained by reference to the everyday practice of the amateur photographer when he uses a yellow filter on his Kodak to subdue the blue of the sky in a landscape. He is then merely reducing the photographic strength of one colour.

The block maker, by the same general means, allows only one of the three primary colours to pass into the camera at a time. He photographs through a purple glass to obtain an image of the yellow, through a green glass to obtain the red, and through an orange glass to obtain the blue. In this way he makes three negatives which between them include all the tone values of the original design.

At the time of making these negatives they are broken up into dots by the use of the half-tone screen as in monochrome work already described. These dots are of varying size according to the strength of the individual colour on any given part of the subject. The detail of these blocks is just like the fragments shown at (110) and (112).

In the reproduction of subjects which have strong tones and heavy depths it is usual to make in addition a fourth plate for printing in black. A portion of a subject reproduced in four printings by this method is shown (127).

Sometimes there is a special colour which predominates in the design, and which cannot be obtained to a sufficient brilliancy or depth by the mixture of the three primaries. A special plate can be made for this eventuality. The actual result of this filtering process is best understood by studying the example.

SUPPLEMENTARY HAND WORK

Purely mechanical filtering of the colours would produce a printed result very far from the original design, and a great deal of highly skilled re-etching has to be done on the plates to bring every part of each plate to the requisite strength. After this a complete proof is pulled, and any necessary adjustments are made by the block maker, who will sometimes engrave away by hand with a burin such parts as are too strong in one of the colours.

RIGHT USE OF COLOUR HALF-TONE

Clearly this is a process which can reproduce an unlimited range of colours, and it is most rightly used for the reproduction of objects of merchandise, or of paintings not originally prepared for reproduction. Its versatility is responsible for the prevalence of printed reproductions of paintings to the exclusion of designed pieces of printing. Many magazine covers are reproduced by this process with a positive indigestion of the whole palette.

The designer should make use of coloured half-tones to produce results especially suited and duly controlled.

The best-suited type of design is one composed of a limited number of graduated colour tones, either alone or in juxtaposition with solids.

It is worth noting at this point that the cost of trichromatic blocks is high, and unless a very large quantity of copies is required it is cheaper, as well as more desirable æsthetically, to use one or two more colours by the line block method, which can be printed on more pleasant, stronger and cheaper papers.

A design for trichromatic blocks may be built up from solid objects of various textures and from any kind of material. In attempting this a reasonably flat relief should be aimed at, so that the photographer may not have difficulty in obtaining



By courtesy of "Hafslund"

From a painting by Ben Nicholson

128. Four-colour process blocks.

sharp focus on all parts of the subject. Only objects that will remain completely still can be so dealt with, because the exposures are lengthy owing to the use of colour filters.

For example, one might imagine a cover design for a booklet on marble being built up by placing some fragments of coloured marble in definite relative positions with an architectural blue print as a background.

The whole thing must be arranged in the block maker's studio so that he is able to make his various colour negatives direct from it. Such a design could also be worked out in most interesting ways with fur, fabrics, pottery figures, and in fact with any kind of object, together with pieces of painted design.

The result would have the quality of photographic realism in colours, and would therefore rely for interest upon the arrangement and combination of the materials making up the design.

It is now possible to obtain original photographs in colours on paper, and to make trichromatic blocks from these. The method enables the exact composition to be viewed in colour before embarking on the making of blocks, but it has the disadvantage that a second mechanical rendering of the colours is introduced, with the attendant further departure from accuracy. These colour photographs can, however, be made from slightly moving objects, such as studio figure models and out-of-door subjects.

There are interesting possibilities, however, even in these 'slave' processes, if the designer is working intentionally for printing. The working of half-tone blocks over one another in a series of colours can be approached by preparing a separate black-and-white wash drawing for each colour, without having recourse to filtering.

These drawings would be similar in quality to the impression in black (129*a*) of a block for printing one colour of another design.

An experiment is also shown (129*b*) in adding a printing in 'line' to a squared-up half-tone printed in colour. The half-tone in this case is made with a curved one-way screen.

The keying of the different parts of the design in the different colours is best done by making the wash drawings on white paper laid over a careful tracing of the original, and worked for accuracy on the tracing frame referred to elsewhere (105). If the key of the design were traced on to the drawing paper the pencil line would be apt to appear in the finished block as a definite line in the lighter parts.

BACKGROUNDS AND QUALITIES

Half-tone blocks are then made from these drawings, and in the simplest form of block all white paper will be represented by a very pale tint of the colour in which each block is printed, because even white paper is rendered with a very fine dot over it. This surface of fine dots can be cut away by the block maker if required, just as in deep-etched monochrome half-tone already described. Such deep-etched blocks are more expensive than plain, or squared-up blocks, but they have the advantage of giving a white background to the design.

In 'trichromatic' block printing, by reason of the half-tone nature of the individual blocks, there are the same limitations as to paper surface as in printing from monochrome half-tone blocks. The most truthful reproductions can only be made on highly glazed coated paper. More sympathetic effects can be obtained by printing on uncoated papers, but the blocks must be specially prepared for this purpose, and it is therefore most important, when ordering, to make it clear to the block maker what sort of paper is to be used.

Colour half-tone blocks could also be made with any of the special screens referred to in the chapter on Monochrome half-tone blocks.



129a. Black impression of deep-etched half-tone block for colour printing.



129b. Line added to colour half-tone.

(C) PHOTOGRAVURE

GENERAL

Photogravure, the chief Intaglio process, is based on the principle of the mezzotint, but is applied for printing considerable quantities. It is also based on photography, as its name implies.

MAKING THE PLATE OR CYLINDER

A positive is first made from the subject to be reproduced, and this is printed photographically on to the surface of either a plate or cylinder of polished copper. Immediately afterwards a continuous screen of crossed lines, a magnified portion of which is shown (130), is printed on top of the image. This screen forms an acid-resist of crossed lines which serves as a bearing surface for a scraping blade in the process of printing.

After these two photographic printings have been made the plate or cylinder is etched. The screen of crossed lines is completely protected from the action of the acid, whereas the spaces between the lines are bitten out by the acid, in proportion to the strength of the light passing through the continuous tone positive of the subject. In this way a series of pits are bitten into the copper surface, varying in depth according to the strength of the resist.

There is a tendency for the contrasts of the original to be reduced in the printing on to the copper, just as in half-tone block making, or in any other photographic copying process, so that a certain amount of working-up by hand has to be done on the positive to counteract this. It is a characteristic of cheap photogravure, where this working-up of the positive is



130. The photogravure screen magnified.

minimized, to give what photographers call a 'soot and white-wash' effect, that is, a loss of middle tones and an accentuation of blacks and whites.

PHOTOGRAVURE PRINTING

The bitten-out pits are first filled with an ink of thin consistency and a spirit nature, by flowing it over the entire surface of the copper. The surplus ink is then removed by a scraping blade, which passes over, and bears on, the crossed lines. The varying quantity of pigment in pits of varying depth produces the gradations of tone in the resulting print when the paper is pressed on to the plate. The ink dries partly by absorption, but mainly by quick evaporation. Various examples of photogravure work are shown, from a photographic original (131*a*), from pen and wash drawing (131*b*), and from crayon drawing (131*c*); in the last two examples the background has been stopped out on the negative. Compare with litho (56), where no ground tone occurs.

The grid of fine crossed lines, which appear light in tone and comparatively even in width over the whole of the print, provides the characteristic quality by which a photogravure print may be recognized. When prints are made on certain papers, however, these lines are sometimes hardly visible, which is, of course, a quality to aim at.

Lettering or printer's type, when reproduced by photogravure, is apt to look ragged because of the effect of the grid of crossed lines, which breaks up the precise form of the letters.

The principal advantages of photogravure over other processes lie in the rich depth of ink obtainable, and in the fact that non-coated papers can be used. Beyond this there is the commercial advantage of the cylinder's having great durability. It can therefore be subjected to long runs at high speeds. On the other hand, the initial work of preparation is costly, and somewhat inflexible.



From a photograph by T. A. Lahman

131a. Photogravure from photographic original.



131b. Photogravure from wash drawing.



131c. Photogravure from crayon drawing.



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JOHN HENRY CARDINAL NEWMAN

Photogravure in full colour.

The process is described as inflexible because when once the work to be printed has been photographed on to the copper it cannot be altered in any way. If even the slightest alteration is required a new cylinder must be prepared.

Most commercial photogravure printing is done in a machine which has a copper cylinder, on the surface of which the image is etched, as described. This cylinder rotates in a trough of pigment, and as the surface of the cylinder rises from the trough it passes under the scraping blade already mentioned, which scrapes the surplus pigment off the surface and allows it to fall back into the trough. The cylinder is then ready for the printing paper, which is forced into contact with it by the pressure of another cylinder. The paper is either in continuous reels or in separate sheets.

SPECIAL FEATURES

Some work has been done with a special bearing screen to take the place of the usual ruled lines or grid. The quality of such a pattern when etched must be such as to bear the knife edge continuously, so that it does not dig into the etched interstices of the copper surface. This pattern is similar to the 'Erwin' half-tone screen shown on p. 111 at (124), but it is very fine in scale, and in use is almost invisible. Such a bearing screen is not much used, because it does not so well withstand the scraping action of the blade.

Journals and picture magazines are frequently printed from photographic originals by photogravure, more particularly on the Continent, where quantities are perhaps greater.

Colour filters are employed just as described for Colour Half-tone and Half-tone Offset, for making colour reproductions in photogravure of water- or oil-colour paintings, with great richness of colour and tone in the resultant print.

The process has also been successfully used for reproducing from crayon or charcoal drawings, and an extremely close reproduction of a crayon drawing in colours could be made by

photogravure from separate black crayon drawings for each colour, thus eliminating the colour filtering process. The softness of the printing quality is supported by the clear transparency of the spirit ink, but such a subject would need to be printed on a matt-surfaced paper. To obtain a white background to such a drawing the negative must be painted out so that it is quite opaque over the whole of the ground. This is very elaborate work on a detailed subject. This matter is further dealt with on page 126 under Collotype.

Paper quality has much to do with the appearance of the finished print. Most of the cheap magazines, catalogues and leaflets printed by photogravure are done on quite smooth, almost shiny paper, because such paper needs less ink, and causes less wear to the copper surface than a rougher one. A far more pleasant result is, however, to be had by printing on paper of egg-shell surface.

HAND PHOTOGRAVURE

Hand photogravure is an earlier form of this process which, owing to its higher cost, is now little used. In place of the ruled screen a very fine dusting of bitumen powder is allowed to settle on the plate which, being lightly melted, adheres. This forms an almost imperceptible screen of fine dots, which constitute an acid-resist. Thus a bearing surface is formed which fulfils the purpose of the ruled screen when wiping off the surplus ink. Wiping must, however, be done by hand.

In the best work by this method there is practically no visible texture in the gradations of tone, but great depth of colour. The result is almost identical in appearance with that of a photographic carbon print.

DESIGNING FOR PHOTOGRAVURE

Wash drawings or body colour drawings are suitable. A series of black originals may also be prepared for printing in a series of colours one over the other. This can be done exactly as when working for half-tone or for half-tone offset litho in a

controlled series of colours. In fact the method and the result is in the main the same, except for the greater depth of colour, than in photo litho offset, and the fact that, with an understanding of paper qualities, a softer and richer result can be obtained without the use of the coated or art papers principally employed for letterpress half-tone.

(D) COLLOTYPE

GENERAL

Collotype is a planographic process, with certain further similarities to lithography. It is a most attractive process of a purely photographic nature, and is principally used in reproducing designs containing delicate gradations of tone and pure colours, and from which only a moderate number of copies is required. A further essential characteristic is that printing by collotype can be done on hand-made paper. For photographic illustrations in fine bookwork the process is therefore of great benefit.

MAKING THE PRINTING PLATE

The working of collotype, however, is slow, and requires great care and skill, not only in the preparation of the printing plates but in printing the copies. Carefully controlled atmospheric conditions are essential for the best results.

The printing plate is prepared as follows. A sheet of plate glass $\frac{1}{2}$ " thick or more is first given a roughened surface by rubbing with fine emery, so that photographic emulsions will adhere to it. A substratum is then floated over it, mainly composed of albumen.

When this is dry the sensitive coating of gelatine and potassium bichromate is floated on and the plate is placed in a specially constructed drying oven. This is a light-tight box with wooden sides, an iron floor and a black cloth lid. On the floor sand to a depth of a few inches is spread, and under the iron floor gas jets are used to raise the temperature of the box to 120 degrees. The sand acts as a diffusing medium to spread the heat evenly. The fabric covering of the lid permits moisture given off in drying to escape.

Within the box three adjustable screw supports are provided to form a base on which the coated glass plate is laid in an

exactly horizontal plane, so that the coating does not flow and become thicker at one part than another.

This box has to be absolutely free from any risk of vibration, as well as from variations of temperature, or the gelatinous coating would dry in an irregular way. When dry the collotype printing plate is ready to receive the image.

Continuous tone negatives are made to the required sizes of the subjects to be dealt with. These are arranged in correct relative position on the glass of a printing frame, and the intervening spaces, possibly forming the margins of a book, are covered with tinfoil, so that all is opaque except the actual negatives to be printed.

The collotype printing plate is then placed in contact with this composite negative and exposed to light. The bichromated gelatine film is hardened in exact proportion to the strength of the light passing through the negatives in their various parts.

The exposed printing plate is then immersed in water for two hours, after which it is dried and allowed to mature for twenty-four hours or more.

PRINTING

When the plate is about to be printed it is immersed for twenty minutes or so in a solution of glycerine and water. This penetrates the gelatinous coating in inverse proportion to the amount of hardening that has taken place in the printing, and so renders the plate proportionately retentive of moisture.

The printing plate is then put in a machine similar in general principle to a lithographic printing machine. There are, however, no damping rollers, because the glycerine-soaked plate is itself sufficiently retentive of moisture.

In place of the damping rollers a second set of ink rollers and attendant ink slab is provided. One set of rollers is covered with nap leather skins as in lithography, and the other set is of a composition similar to letterpress rollers, but of slightly

different composition, in order that they shall withstand the action of the moisture in the plate.

The nap rollers supply the ink, which is of a very stiff consistency, and the smooth rollers clear the plate of superfluous ink and sharpen up the image.

The graduation of moisture content in the gelatine coating causes the graduated feed of ink, and so produces the even gradation of tone in the print without recourse to the breaking up of the image into dots (132*a*).


WHITE BACKGROUNDS

There is a slight similarity to the 'half-tone' process in that even the whitest paper in the original will, unless specially dealt with, produce a slight tone in the final print. Unlike direct lithographic drawing, to get an absolutely clean paper background, painting out by hand on the negative of the entire background must be resorted to, otherwise a squared-up panel of faint tone with the design upon it is the result. On plate (132*b*) the tone has been stopped out on part of the background. In this respect the method is exactly similar to photogravure.

This work requires great neatness on the part of the retoucher, as he must paint over all the interstices between the lines of the design, and each side of every line in the drawing. In cross-hatched parts he must paint all the little squares left between the intersecting lines.

Although this work is done with astonishing skill by good retouchers, one cannot help feeling that there must be a certain lack of directness in the result which makes it undesirable for the finest and most personal work, and that a slight tone on the background is preferable to the painting round of the work.

In collotype, pressure is even over background and work alike, so that the most delicate edge of a drawing can be reproduced softly.



132a. Evenly graded tone obtainable with collotype.



132b. Brush drawing on white paper, background tone left in part.



132c. Portion of photograph reproduced by collotype.

Throughout the printing operations the atmospheric conditions must be kept even, both as to temperature and moisture content of the air, so that the moist gelatine film may retain an even quality. Examples of collotype from various originals are shown (132*b*), (132*c*).

COLLOTYPE IN COLOURS

As in all other printing processes, a series of printings, each in a different colour, can, of course, be carried out to reproduce coloured designs. The technique of colour filters is employed in making the various negatives, when the original is completely coloured.

Offset lithography is frequently combined with collotype for the rendering of flat colours, that is, colours in which there is no gradation of tone: the stones for these are drawn by hand.

Collotype is very useful as a subtle base in monochrome for colouring with water-colour stencil work. In this case, again, the black wash or line original for the collotype printing should be prepared and left uncoloured until it has been reproduced by the camera. Afterwards actual collotype prints may be coloured as a guide to the stenciller.

THE COLLOGRAPHIC PROCESS

This is so similar in general idea to collotype that little need be said about it except that it is a faster process. The same remarks as for Collotype apply regarding the preparation of the originals. Printing is done from films coated on celluloid instead of on plate glass. The films retain moisture much longer and the greater speed of work attained by this method reduces costs, though it must also jeopardize the certainty of the finest result.

DESIGNING FOR COLLOTYPE

As has been suggested for colour half-tone reproduction, the filtering process may be avoided by preparing a series of black

drawings in wash, and printing these in a series of colours. This has not been experimented with to any great extent by artists in this country. Such a series of working drawings printed by collotype in the delicate gradations of colour characteristic of the process would be capable of very subtle results.

OF PHOTO COLOUR METHODS IN GENERAL

Technique is so advanced that it can now reproduce anything, but one cannot too often emphasize the advantages that accrue from preparing a separate set of black working drawings for a series of colour printings; or at least from conceiving a design in such a way that this can be done by the printer.

As set out at the beginning of this book, on page 6, in printing, 'each colour is a separate working', and each printing should therefore be designed in itself, overlapping of one colour upon another being consciously planned for where required.

Processes are, of course, rightly used for the reproduction of paintings never intended for printing designs, but a 'painting' made without forethought of reproduction is not rightly a design for printing. Such methods lead to much overlaying of colours.

There is inevitable superiority of effect when the individual colours of a well-planned scheme are allowed to be seen in individual clarity.

PART III

BOOKBINDING

It falls within the scope of the design of a bookbinding to determine the materials of the actual cover, and to this end it must be explained that binding falls into three main classes (133): Full, Quarter, and Half Binding.



133. Three main forms of binding.

FULL BINDING

in which one piece of material forms the outside of the book. This may be 'full cloth', as in the ordinary cloth-bound novel. Full leather, full vellum or full paper are used each in its own province. In the last case the paper may be printed by any of the processes mentioned in this book, and cloth for binding has also sometimes been so printed before handing to the binder for making up on the book.

QUARTER BINDING

in which the boards of the binding are covered with one material, and the 'spine' or flexible part of the binding is covered with a different material. The most usual combination is perhaps to cover the boards with paper, either plain, printed or patterned, and the spine with cloth, leather or vellum. Good

paper, when well pasted down on to cardboard, has probably a greater lasting power than leather.

The width of the material used for the spine may, at the discretion of the designer, be varied so that it covers more or less of the board's width.

HALF BINDING

in which the last-mentioned style is augmented with corner pieces on boards of a stronger material than that used on the boards themselves, usually of the same material as that used for the spine. These corners may be almost imperceptible or they may cover an appreciable area of the cover.

There is considerable scope for the assembling of different materials, textures and colours, in these manners of binding, as well as in the actual design, which may be impressed either with gold or without.

INLAY BINDING

Materials may be inlaid one upon the other, or different colours of the same material may be intermixed. In this case the actual shape of each part of the design must be cut out by the binder in the material required, and the various pieces assembled in exact position on the board of the binding and pasted down.

This is best carried out in leathers of different colours, because leather can be pared at the edges, and, when made supple with paste, these edges stick down firmly and permanently. A piece of vellum pasted down at its edges over leather is apt to become very hard and stubborn as it dries, and is therefore liable to peel up at the edges if the binding is subjected to the slightest climatic change after it has left the binder's hands.

Inlay work is clearly only suitable for the more expensive types of binding. It must be kept very simple in design to be practicable for moderately priced books.

GILDING ON BOOKBINDING

The method of applying gold leaf to binding is as follows. The leather or cloth is first 'glaired', that is, it is wiped over with white of egg or resin powder, which, when heated locally, will become adhesive. Vellum, by reason of its slightly glutinous nature, usually needs no glair; a very slight rub over with resin powder may be advantageous, but no residue of loose resin must be left.

The gold leaf is then laid over the whole surface on which gilding occurs, and the brass plate of the design, or tool, having been heated to the temperature of an ordinary household flat iron, is pressed into the leather or cloth. The heated brass, coming in contact under pressure with the glair through the gold leaf, causes the gold to adhere on the design. The remainder of the leaf is wiped off with a ball of specially prepared mastic rubber, which ball can, when replete, be melted down by a gold refiner. A considerable wastage of gold is thus recovered.

BRASS BLOCKS

Brass is necessary for good gold blocking on leather, vellum or cloth, because it is hard enough to overcome the roughness of these materials. Brass will take a high polish, and so impart that polish to the gold leaf. It will also stand the necessary heat without loss of surface polish.

Brass relief blocks for bookbinding are seldom cut by the artist, because he has no experience in dealing with the hard metal. Furthermore, the wall of the effectual surface must be so clean and sheer that a good result would be unlikely without much practice and the right mechanical aids.

The design for a brass block must be crisp and definite. Detail must not be so fine as to lose its charm when pressed into the rough surface texture of the material. A block for vellum can be finer than one for cloth or leather, while one for buckram must be broader in treatment.

The design may be drawn in indian ink on white paper, or it may very logically be engraved on wood and a print made from which the brass block cutter will work. In either case the design should not be too complicated. This design by Kruger



134. Impression of binder's brass block.

Gray (134) is a good example of the amount of detail one should expect for a reasonably smooth cloth binding.

The design is usually photographed in the first place on to a plain blank of highly polished brass. The margins must be cut quite sheer to a depth of $\frac{3}{32}$ " below the face, and the interstices of the design equally sheer to $\frac{1}{16}$ ". Within the finer white

details, as in the hair of the tails and around the lettering, the depth is $\frac{1}{32}$ ", but in all cases the wall from the blocking face must be quite vertical.

This is because the brass will be fixed and heated in a press and forced into the somewhat giving material of the book cover.



135. A binder's brass block.

Any broadening out below the face of the block would therefore touch the gold leaf, and cause it to adhere to the cover, so destroying the sharpness of the design. The larger areas of unwanted brass are routed with a kind of drill, set to cut to an even depth. A photograph of the brass ready for use is here shown (135).

Lettering, it seems logical to suggest, should follow a 'type'ish manner, in that the brass which must be cut for it has so much of the typecutting technique; in fact, it may well be set in

printers' type as a model for the brass cutter. Lettering, like the design, should be free from very fine lines, as the effectiveness of gold is largely in its reflection of light, and only broad surfaces produce this.

There is no short cut available by etching, for there is no acid that will eat out brass cleanly and quickly, as there is for zinc and copper. Zinc etched blocks are sometimes used for cheapness, but zinc does not stand up well to the work, and the gloss on the gold is in consequence sacrificed.

Blocking can also be done with coloured foils in the place of gold leaf, but for these a broader effect with less detail is desirable.

INDIVIDUAL BINDINGS

Designing of decoration for the individual binding of one copy of a book is quite another matter. Gilding on such work is mostly done with hand tools cut on brass blanks, mounted in wooden handles, and with 'rolls' or wheels with plain or patterned edges, which, rolled along the leather of the binding, leave a continuous mark in their wake.

It is necessary, therefore, to work with a knowledge of the equipment of the binder who is to carry out the design.

It is safe to assume that all binders' stock includes plain rolls giving various widths of line, and a wide variety of gouge-like curved tools, which can be used to build up almost any arrangement of plain lines. For lettering, there are various binders' alphabets of separate letters which can be built up into words, but these frequently are not of a very good standard of design.

A design for an individual binding must be made in ink or pencil on thinnish 'detail' paper, and to the exact size of the binding. This will be laid directly on to the cover, and the hot tools will be pressed through it into the leather, so that the design is 'marked' in faintly direct from the drawing. The paper is then removed, and the gilding is carried out, following

the 'blind' marking of the tools. If some of the design is to be 'blind' in the final result, or stained, and some in gilt, two coloured inks may be used in designing, and instructions written in the margin. Inlaid areas can be washed in with water-colour.

A full colour picture of the binding, if thought necessary, must be made on a separate sheet.

BOOK EDGES

The edges of the leaves, whether for one book or for an edition, are also sometimes treated in various ways. They may be stained or splashed, and the tops, or all edges, may be gilded to keep out dust. They may be roughed with a saw, then stained and gilded on the rough surfaces. This should not, however, be done to the top of the leaves, for the main purpose of edge gilding, which is to keep out dust, would be lost. In some cases they may be cut smoothly and then painted with decorations, but this all adds considerably to the cost.

CONCLUSION

This concludes the range of processes set down as a synopsis at the outset of this undertaking. There can be no finality, for new processes are constantly being developed, and new ways of combining one with another are discovered every year. There are so many possibilities that the practice and use of printing is always fascinating and flexible.

The fact that we live in a mechanical age does not justify submerging or eliminating the controlling artist, nor will the artist get the most out of the machine and the mechanical process without mastering techniques and bending them to his will.

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